THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XV.—No. 348.

INVENTORS AND CAPITALISTS.

READERS will have noticed a somewhat lengthy epistle in our last week's number from the pen of the plaintiff in the case "Heinrichs *v.* Westinghouse," judgment in which was recently given by Mr. Justice North, and duly recorded in our columns. In this issue that letter is supplemented by a sympathetic contribution from another correspondent, who takes opportunity to protest against what he alleges to be the facility with which inventors may be defrauded out of their just rights by those who are favoured with the possession of those two all-powerful agencies—money and influence.

We gave to Mr. Heinrichs more of our space than is ordinarily allotted to one correspondent, because we recognised that in the case in which he was concerned there arose several points of very considerable interest to a large portion of our readers.

Without entering upon a reiteration of the facts brought forward in evidence, which are sufficiently dealt with in the correspondence to which we have called attention, we may remark that an agreement was entered into by Mr. Heinrichs, inventor of the Heinrichs dynamo and lamp, which have been described in these pages, with the proprietor of the well-known Westinghouse brake, and it was as to whether the terms of that agreement were observed by the latter that Mr. Justice North's attention was directed upon the occasion under notice. He found that they were, excepting in so far as they were varied by a subsequent arrangement, mutually acquiesced in; and that the plaintiff himself had not complied with the requirements of that arrangement to an extent that would justify him in bringing an action against Mr. Westinghouse for non-fulfilment of the original agreement.

One of the matters wherein Mr. Heinrichs, according to Mr. Justice North, had put himself "out of Court" was as to the completion of his machine, "already made" at the date of the agreement: but how far this particular question affected the decision as a whole it is difficult for us to say. Certain it is, however, that—quite naturally, perhaps—the learned judge has allowed himself to fall into a decided error here, in consequence of his misapprehension of the proper meaning of the word "complete" as used in this instance in regard to the construction of a dynamo machine. That his Lordship was altogether at fault in his findings we do not for a moment suggest; but, although he went to considerable pains to grasp the facts and conscientiously pursued his investigations to an extent that is not always considered requisite, he was, as he himself confessed, unable properly to understand the plaintiff's contentions.

His remarks as to the incompleteness of the machine were based on allusions in the evidence to certain hitches which occurred during experiments at Paris, but which were quite satisfactorily explained as in no way affecting its practicability or utility; and to defects in some parts of the lighting arrangements which, although used in connection therewith, really formed no part of the plaintiff's patented invention. The testimony of several competent witnesses clearly showed that the machine was complete and in efficient working order some time prior to the date of the agreement. Another point which favoured the idea in the learned judge's mind that the machine was unfinished, was that there was evidence of operations for attaching to it a new commutator. This new commutator, although the inventor imagined it might be an improvement, was by no means a necessity for the completion of the dynamo, which had previously, as it has since, worked with great success with what we believe was the commutator in use at the time the agreement was entered into.

It is evident, from a perusal of Mr. Justice North's judgment, that it was Mr. Heinrichs's tacit acquiescence in the arrangements for remaining in Paris, and in other variations of the plan first agreed upon, that was really fatal to his claim. It is easy to understand, however, that his reasons for such compliance were his desire to keep upon good terms with Mr. Westinghouse and his hope that facilities would be afforded him in Paris for pursuing his experiments. That adequate facilities were *not* provided will be patent to all electricians, and our readers will readily conclude, with us, that great injustice was thus done Mr. Heinrichs. Had his system been put upon the market in 1882–1883 it should have been now as well known and as much used as the Brush, Gramme, or Siemens. From the peculiar nature of the agreement, however, he was debarred from making terms with any other party likely to take up his invention, even after he terminated his connection with Mr. Westinghouse, and that he sustained considerable pecuniary loss in consequence is unquestionable. Even now, it seems, he is so far bound by that agreement that he is not at liberty to proceed to a realisation of the full value of his invention; and how he is to free himself is by no means clear. Mr. Justice North stated that, the agreement being duly registered, he "could not cancel and make it void under any circumstances," a statement of a startling character, suggesting that one party to an agreement may neglect and refuse to comply with its stipulations to any extent he pleases, and yet insist that it shall remain in force, however inconvenient to the other contracting party. No after remark occurred in his Lordship's judgment to explain this passage, or to define what acts would justify a request that an agreement might be cancelled.

Taking the main points insisted upon by Mr. Justice North to be correct, we much fear that Mr. Heinrichs would profit but little by an appeal; at any rate, even so far as it has gone, the case furnishes one more warning to inventors to be particularly careful in their dealings with capitalists, to be scrupulously observant that their agreements shall not be so worded as to bind them hand and foot whilst leaving the other parties free to act as they think proper, so long as they do not actually violate the specific terms.

THE ELECTRICAL RESISTANCE OF THE HUMAN BODY.*

IN my communication to *Nature* (vol. xxix. p. 528) I described the use of alternating currents and the telephone for the above purpose, and promised to endeavour to obtain at least an approximate measurement of the E.M.F. developed in the secondary coil of an induction apparatus. This promise I now propose to fulfil. But before proceeding to the special subject of the present note, I should wish to draw attention to a paper which appeared on the 15th of the same month in the *Asclepiad*, by that able experimentalist Dr. B. W. Richardson. He therein describes not only experiments made with the large induction coil of the Polytechnic, but also others made as early as 1868 in conjunction with the late Mr. Becker, the object of which was to obtain a measure of the resistance of animal structures.

"The results," says Dr. Richardson, "were not fully satisfactory. They were variable even when the conditions under which the experiments were made were entirely the same. This variability we found to be due to decomposition of the animal substance, a decomposition which, however feeble the battery, was sufficient to destroy the precision we desired to obtain." Putting the more recently coined word "polarisation" for decomposition, this expresses exactly the difficulty described by me in my first note. "It was, however, possible," says the doctor, "to make out that blood conducted better than any other structure of the body, and better than water." I can now fully corroborate this excellent observation, and perhaps extend its application.

Physiological and even pathological fluids, such as the serum of dropsy, conduct far better than muscle, bone, and nerve. One instance out of many may serve. In the very first case recorded in my communication to *Nature* (vol. xxviii. p. 151) the lowest resistance obtained from foot to foot was 2,300 ohms. The patient was then very emaciated, but quite free from dropsy. Towards the end of the case, which after death proved to be one of ulcerative endocarditis, as I had considered it to be during life, slight but distinct dropsical effusion in the lower extremities set in; the resistance sank at once to 700 ohms, and I had to discontinue my observations from the evident change of electrical conditions. I have since verified the same fact many times, and on it I partly found the belief, already several times stated, that "the human body, in spite of its large amount of liquid constituents, follows a similar thermal law of resistance to that influencing solid conductors, though in a very much higher ratio" (*Nature*, vol. xxviii. p. 152).

Dr. Richardson does not seem to have attempted to determine the resistance of the living body, which Du Moncel, in 1877, did, and with fairly accurate, if unpleasant, results. (*Nature*, vol. xxix. p. 528). On the discovery, however, in 1879, of Prof. Hughes's electric balance, he resumed his observations, this time with an alternating induction current, though he does not himself notice the important change. His results are unfortunately taken in arbitrary units on the graduated scale of 200 parts originally applied to Prof. Hughes's instrument. If there is any way of reducing these fictitious to absolute values, my work will be both lightened and assisted by a proved observer. Blood-clot and serum, white and gray nervous substance, muscle, bone, coagulated albumen, gelatine and pus were all tested. Some of the results were excellent. For instance, fat, which by one experimenter has been stated to increase the conductivity of the body, is found by Dr. Richardson, as I also have found it, to be an absolute non-conductor. It is almost unnecessary to say that, with so skilled a chemist and physiologist, all proper temperature corrections and other similar precautions were most strictly observed.

I can now proceed to the main topic of my present note. On receipt of the Wurzburg dynamometer it was put in adjustment, and a strenuous effort made to compare the indications given with a constant and an alternating current, to both of which it is sensitive. But the movable suspended coil made of an ivory core, with a double weight of silk-covered copper wire, hung by a platinum hook, and dipping by its other termination into a vessel of strong sulphuric acid by means of a platinised platinum plate, is very heavy; takes a long time to get to its full deflection, thus allowing the battery to run down sensibly, and, what is worst of all, has a tendency to "integrate." By this I mean to sum up, by its mechanical inertia, a large number of small, intermittent pulls as given by the reversed current, into an almost identical deflection (less, of course, losses) with that given by the one steady pull of a continuous current. In spite of its beautiful workmanship, it had to be discarded for the present research. Somewhat in despair, I fell back on a similar instrument, shown by me at the Oxford meeting of the Physical Society in June 1882, and there heavily abused. The moving coil in this is made of silk-covered aluminium wire to insure lightness, and the bifilar suspension is made of the silver-gilt wire used for military epaulettes and facings. It is the work of my own poor hands.

Herr Obach then stated, and the statement was repeated in your columns, that this material had already been used by Messrs. Siemens for their "dust-recorders," but had failed by difficulty of making contact. On testing my little toy, I found its resistance had not altered in 25 months one fraction of an ohm, and that it moved briskly up to its maximum, standing there quite long enough for a good observation. Indeed, in spite of its condemnation by a jury of experts over two years ago, it was still so lively that I thought it better to check extra swing by a small platinum paddle 1 cm. square moving in sulphuric acid.

On a metre scale, at one metre distance, the reflected image in a telescope gave ·365 mm. deflection* with the whole induction current from Prof. Kohlrausch's metre-bridge, as described in my last note.

The object now was obviously to obtain an independent measure of the actual E.M.F. to which this deflection was due. The quadrant electrometer, or some other delicate potential measurer, of course suggested itself. A trapdoor portable, kindly lent me by Prof. McLeod, refused to take notice of my wretched little currents, limited as they are by human susceptibility. I do not possess a quadrant, nor will the Royal Society, though twice asked, lend me one. Here, again, my friends at Cooper's Hill came to my rescue, and I have to express my thanks, not only to Prof. McLeod, but also to Prof. Stocker and his excellent demonstrator Mr. Gregory, for their assistance. With my Kohlrausch induction bridge in a big bag I journeyed to Egham, and thence on foot to Cooper's Hill.

The formula to be made use of was obvious. It is given in Prof. Adams's Cantor lectures, and has been kindly verified for me by Prof. Hopkinson. In it the needle is connected with one pair of quadrants, so that $v_3 = v_1$. In this case—

$$\text{Deflection} = \frac{k}{2}(v_1 - v_2)^2.$$

Prof. Adams has since shown me a different, and perhaps better, way of working, which I intend to make use of in the future. It was found that the two fine quadrant electrometers at Cooper's Hill College were unavailable; the one given by Lord Salisbury not admitting of the needle being placed in connection with either pair of quadrants, the other being disabled by some casual contact. We therefore with heavy hearts made a last struggle with the old Elliott pattern and single quadrants. This succeeded admirably, and on a mean of the four best out of six observations, we obtained a deflection of 107 with the intermittent current. "In order to be quite sure," Mr. Gregory wrote to me next day, "of the true value of the mean

* From *Nature*. Fourth Note by Dr. W. H. Stone.

* The bridge arrangement being entirely disconnected.

deflection we obtained, I have executed measurements with different numbers of cells. In these, the negative pole was to earth, the positive being connected at will to either pair of quadrants, and the needle also at will to either pair, giving four readings for each observation. I give only means, which agree well.

E.M.F.		Defl.		k.
21 volts	...	32·75	...	·149
29 „	...	63·75	...	·151
47 „	...	161·75	...	·146
Mean	...	...		·1486

k was calculated from the formula

$$\delta = \frac{k}{2}(v_1 - v_2)^2.$$

By calculation, using the mean value of k, the E.M.F. to give a deflection of 107 came out 38. By observation, using an E.M.F. of 38 volts, the deflection was 107·25. This agrees so well with the calculated value that it will be easy to evaluate the E.M.F. corresponding to any deflection by the above formula."

The effect of rapid alternations seems to be to lessen the deflection, though Mr. Glazebrook stated, in a paper read before the Physical Society, that with between 10 and 120 contacts per second the result, in charging a condenser, was not perceptible.

On the whole therefore, though I agree with Mr. Gregory that we have not obtained a measure of the maximum E.M.F., but only an integration, disregarding sign, the approximation is, I hope, superior to any made before, and affords a good general basis for further work.

INDUCTIONAL TRANSFORMERS.

THE induction coils employed in our laboratories do not seem to have been specially studied and constructed with reference to yield. These apparatus being simply designed to produce very high potentials, Ruhmkorff and the other constructors have determined their arrangement empirically on this condition alone, without concerning themselves with the proportion between the total electric energy developed by the battery and that collected on the induced wire. The induction transformations, with which electricians occupy themselves at present with a certain activity, and which may suit for some applications, are nothing, says M. Chaperon, in *L'Electricien*, but coils approximately similar to the old ones. Hence it will not be uninteresting to collect in an elementary form the theoretical data which intervene in the construction of these instruments, and permit us to investigate the best arrangements.

We have only very incomplete accounts as to the first attempts made for the use of induction transformers on the large scale. M. Jablochkoff certainly made use of them in 1877 to raise to incandescence the plates of Kaolin with which he attempted to fit up a system of lighting. An installation on this system figured at the Exhibition of 1878, and the principle of the use of coils for *dividing* and *distributing* the energy furnished by a single inductor circuit was there distinctly indicated. The generator of the alternating currents which passed into the totality of these coils was a small l'Alliance machine.

The American electrician, Fuller, put forward, about the same time, a very complete project for the distribution of electric energy by induction. He seems to us the first who brought out the most important, but at that time the least appreciated point of the system, viz., the facility which it offers for employing in the inducing circuit a current of very great difference of potential, and of very low intensity; whence, for a given size, there results a considerable decrease in the price of the primary conductors. The primary current is, in fact, furnished directly by the generating machine in the periodic form which belongs to induction, and there is no room, in all its course, either to interpose any organ of commutation or of interruption, or even to place this current within the reach of consumers, whence the highest tensions may be used without great danger.

In spite of this distinct conception of the advantages of the system, Fuller's idea does not seem to have given rise to important practical trials. His transforming apparatus, such, at least as it has been described in France, was of a complicated form and not very advantageous.

The present transformers, those of MM. Gaulard and Gibbs, are, on the contrary, very similar to bobbins. They seem, however, to have been modified since the origin of their use. The first which figured in almost all publications relating to electricity were of an elongated form, and were made by simply rolling up a cable with several wires. One portion of these wires, connected probably in series, formed the inductor, whilst the induced was composed of other wires of the same cable taken in quantity. The total should act like an ordinary coil in which the two wires were mixed, or rolled up, in alternate layers. This arrangement, according to the authors, was very advantageous, and was one of the causes of the high yield of the apparatus. Subsequently other coils have been constructed; such, doubtless, are those small secondary generators of which Dr. Hopkinson speaks in the second part of his report. We do not know if in them the same arrangement has been preserved.

Without stopping at experimental results relative to these different types, which, moreover, are still very imperfectly known, we purpose examining, *a priori*, and by the aid of classical principles, what must be the conditions for arranging a transformation-coil, as regards its yield. The notion of lines of force, the principal consequences of which we shall briefly recapitulate, suffices for this purpose.

We know that when a circuit traversed by an interrupted, or periodic current, is placed in the vicinity of another circuit the magnetic field, or the bundle of lines of force, undergoes changes in space of the same period as those of intensity. In consequence of these changes the lines of force comprised in the wire of the second circuit vary, whence, in virtue of Faraday's experimental principle, there results in this wire an electromotive force proportional to the variation of the number of lines in a unit of time. But the number of lines of force in a given portion of the space is proportional at each instant to the intensity of the inducing current. The variation of the number of these lines with the induced circuit in the time *one*, must therefore depend at each instant on two factors, the number of lines contained in the circuit when the inducing current is equal to unity and the velocity with which the intensity of this inducing current varies.

Of these two factors the former depends evidently only on the form and the position of the two circuits; this is the coefficient of mutual induction. A knowledge of this factor is certainly the more important as regards the useful effect of the two given circuits, for the other (the speed of the variation of the intensity) is connected with the mean electromotive force and the speed of rotation of the generator, which may be made to vary independently.

We will endeavour, therefore, to calculate this coefficient of induction for the simple case of cylindrical coils.

We have said that it represents the number of lines of force of the inducing field enclosed by the induced circuit, the intensity of the primary current being equal to unity. Let us suppose the inducing coil reduced to a stratum, to a simple solenoid; we know that the lines of force form then in the interior of this solenoid a bundle, the density of which, the number of lines per unit of section, is simply proportionate to the number of turns. We have then for a solenoid of a length equal to unity and of a section S, a bundle of internal lines equal to

$$K\, n\, S,$$

n being the number of diameters of the wire comprised

in the unit of length, K a constant, and S the section of the solenoid.

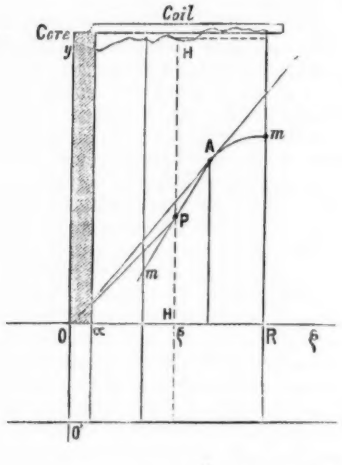
The number of these lines enclosed in one fold of the induced wire will have the same value, $K\,n\,S$, if the fold is outside the solenoid; if inside we must simply regard S as representing the section of this fold. An entire layer of the induced wire supposed to contain N folds in a unit of length encloses N times these same lines. The coefficient then will be

$$K\,N\,n\,S$$

for any two concentric solenoids, S being the section of the inner circle, neglecting the external lines of force, and supposing the internal bundle uniform, which represents a sufficient approximation.

This simple datum suffices for studying the influence of the method of coiling the wires upon the coefficient of induction.

We will suppose, in order to simplify the problem, that the transformer is composed of a sufficiently great number of layers of fine wire, in which the inducing current passes, and of a single layer of thick wire, furnishing the induced current of quantity. This simplification does not vary as much as might be thought from practical data, for the loss in the current of quantity being, all other things being equal, much more considerable than in that of the line, we seek always to make this current pass in a wire relatively short. It is still, however, proper, whatever may be the number of strata of induced wire, to examine if there exists for the first among them any situation particularly efficacious. Suppose that a layer of induced



wire, containing N folds in the unit of height of the coil and of the radius, ρ, is placed in the interior of the inductive strata, of which the extreme radii are a and R. Let us calculate the coefficient of mutual induction of this system. For this purpose we consider first the layers inside the induced solenoid of the radius, ρ. The totality of the lines of force which it contains is effective, and one of them, of the radius, r, gives for the stratum, ρ, a term of the form

$$K\,N\,n\,\pi\,r^2$$

in the length of the radius, $d\,r$, there are, $n\,d\,r$, layers, and in the entire thickness comprised between a and ρ the sum of the terms is

$$\int_a^\rho K\,N\,n\,\pi\,r^2 \times n\,d\,r = K\,N\,\pi\,n^2 \int_a^\rho r^2\,d\,r$$

which equals

$$K\,N\,\pi\,n^2\,\frac{\rho - a^3}{3}$$

In the layers outside of ρ the lines comprised in the surface, $\pi\,\rho^2$, act alone; the terms due to each layer are then all equal to

$$K\,N\,n\,\pi\,\rho^2,$$

and their sum, for the strata from ρ to R is simply:

$$K\,N\,n\,\pi\,\rho^2 \times n\,(R - \rho)$$

or

$$K\,N\,\pi\,n^2\,\rho^2\,(R - \rho)$$

The total value of the coefficient of induction will then be:

$$K\,N\,\pi\,n^2\left[\frac{\rho^3 - a^3}{3} + \rho^2\,(R - \rho)\right]$$

or:

$$\frac{K\,N\,\pi\,n^2}{3}\,[3\,R\,\rho^2 - 2\,\rho^3 - a^3]$$

This very simple value is not much complicated by the introduction of a magnetic core at the centre of the coil—an addition made to all the transformers employed hitherto. We know that the lines of force which fall within this nucleus are merely more numerous than in the surrounding medium, and that within certain limits we may suppose that the ratio of their number to that which it would be if the space filled by the core were empty is determined by a coefficient, C, of very considerable value.

Accordingly, we see that the addition of a core of the radius, a and a, consequently within the circle of the radius ρ, will simply increase the number of the lines of force in the latter, of a value $K\,N\,n\,\pi\,a^2\,(C - 1)$ per inducing layer, or for the total:

$$K\,N\,n\,\pi\,a^2\,(C - 1) \times n\,(R - a)$$

or

$$K\,N\,\pi\,n^2\,c\,a^2\,(R - a)$$

putting $C - 1 = c$: the complete value of the transforming coil with a magnetic coil is then

$$\frac{K\,N\,\pi\,n^2}{3}\,[-2\,\rho^3 + 3\,R\,\rho^2 - a^3 + 3\,c\,a^2\,(R - a)],$$

in which we may regard c as having a very considerable value.

For $\rho = R$ this value becomes:

$$\frac{K\,N\,\pi\,n^2}{3}\,[R^3 - a^3 + 3\,c\,a^2\,(R - a)]$$

$$= \frac{K\,N\,\pi\,n^2}{3}\,(R - a)\,(R^2 + a\,R + a^2 + 3\,c\,a^2)$$

and for $\rho = a$:

$$K\,N\,\pi\,n^2\,(a^2 + c\,a^2)\,(R - a).$$

This is the value for the Ruhmkorff coils used in laboratories, in which one or two layers of thick wire coiled directly upon the core are placed at the centre of a thick coil of very fine wire.

In order to see if it is advantageous to place the first layer or the only layer of induced wire in any particular situation, let us discuss the value of the coefficient expressed as a function of ρ. To render this discussion as clear as possible, let us represent the variations of this coefficient by a curve which we may suppose traced upon the longitudinal section itself of the coil, in such a manner that when the induced solenoid occupies, *e.g.*, the position represented by H H', the coefficient of induction will be given by the ordinate, P H. The curve thus defined gives, then, all things being otherwise equal, a means of comparing the electromotive forces of induction developed in the wire for all these different positions.

We see easily that this curve:

$$y = 3\,R\,\rho^2 - 2\,\rho^3 - a^3 + 3\,c\,a^2\,(R - a)$$

$\left(\text{suppressing the constant coefficient } \frac{R\,N\,n^2\,\pi}{3}\right)$ has its horizontal tangent for $\rho = R$, and is inflected at the point $\rho = \frac{R}{2}$.

The coefficient of induction, and the electromotive force in the induced solenoid of radius ρ reach a maximum when this solenoid completely envelopes the inducing coil. This was otherwise evident *a priori*, and we must not conclude hence that the most favour-

able position for the wire of quantity would be on the outside of the transforming coil. It would only be thus in fact if the resistance of this wire were indifferent, or if we could take it as thick as we wished. In general, the diameter of this wire will be given or comprised within certain limits, and what has to be sought is not the arrangement which gives an absolute maximum of the coefficient of induction, but that which gives the greatest electromotive force per unit of resistance, or of length of the induced wire. The length of this induced wire is evidently proportional to the product, N ρ, and as N enters into the coefficient $\frac{K N \pi n^2}{3}$, the arrangement, which is most satisfactory in general, and for the average of applications will correspond to the maximum of the expression :

$$\frac{y}{\rho}.$$

But it is easy to see that $\frac{y}{\rho}$ represents the angular coefficient of the radius vector, O P, joining the origin to the point where the curve, H H^1, meets the figurative curve. This angular coefficient will be at its maximum when the radius vector is a tangent to the curve. There will then be no maximum unless one or more tangents to this point can be drawn through the point *o*.

A very simple discussion, or the examination of the curve, shows that this takes place only if the tangent to the point corresponding to $l = \frac{R}{2}$ intersects the axis at the right of the point, *o*. This condition is expressed analytically by

$$\frac{P H}{f'\left(\frac{R}{2}\right)} \text{ and } \frac{R}{2}$$

$$a^3 - 3 c a^2 (R - a) + \frac{R^3}{2} > 0$$

We see that this condition is not easily fulfilled in the case where there is a magnetic core, by reason of the magnitude of *c*. It is simpler to examine directly how the curve varies in different cases. We see that the expression of the ordinate

$$y = 3 R \rho^2 - 2 \rho^3 - a^3 + 3 c a^2 (R - a)$$

is composed of a portion which varies with ρ, and of a constant portion, *e.g.*, the value for $\rho = a$. This constant portion is enormously increased by the addition of the core, since it increases by $c x^2$. The effect of this addition in a given coil is to cause the figurative curve of the coefficients of induction to re-ascend in the interior of the coil, as a whole, and without changing its form. We see thus, that the more the effect of the core is marked, the less are the chances of one or two tangents passing by the origin, that is to say, of their being an advantageous position of the layer of induced wire in the inside of the inducing coil.

Summing up in a few lines this somewhat long discussion, we may, from data admitted concerning induction transformers, deduce the following results :—

A transforming apparatus composed of an inducing coil of considerable dimensions and of a layer, or a small number of layers of induced wire, will furnish electromotive forces which vary for a given resistance of this induced wire according to its arrangement internally, or in the folds of the coil.

If the magnetic core is feeble or wanting, there may be in the inducing coils an advantageous position for placing the induced wire. When, on the contrary, the magnetic core exerts a more considerable effect, it becomes more useful to leave this wire in the interior between the core and the fine wire, exactly as in Ruhmkorff's coils.

The mixed circuit transformers of MM. Gaulard and Gibbs are probably placed under conditions much approaching the second of the cases which we have examined.

REVIEWS.

*Galvanic Batteries and Accumulators: Technical Researches.** By EMILE REYNIER. Paris: J. Michelet.

The author remarks at the outset of his work that batteries, which, in the opinion of some authorities, were destined to give place to mechanical electro-motors, are beginning to regain public favour. This is a fortunate circumstance, for the electric light, under our present laws, is not likely to be generally introduced into private houses unless the necessary current can be generated on the premises. This, under ordinary circumstances, can be effected only by the battery. In the first chapter we find, accordingly, an account of the maximum and minimum force of some thirty voltaic combinations composed of two electrodes and a single liquid. He has re-measured some of these couples and has obtained results somewhat different from the determinations of former physicists. The greatest electromotive force (1·26 volts) was obtained with an element of coke as the positive and amalgamated zinc as the electro-negative electrode, with dilute sulphuric acid as the exciting fluid. In the succeeding chapter we find a description of the element which the author proposes as a standard. It is a volta couple of zinc and copper, the surface of the latter metal being 30 square decimetres, and that of the amalgamated zinc 0·3 square decimetre. The exciting liquid consists of 800 cubic centimetres of a solution of common salt, one part to five of water. The electromotive force of this combination is 0·82 volt, and the resistance from one to two ohms. The constancy of this element depends on the excess of the positive electrode, which is 300 times greater than the negative. The author has determined the effects of certain other exciting liquids, among which it appears that a solution of sulphate of zinc gives, with ordinary in place of amalgamated zinc, an electromotive force of exactly 1 volt. Still he does not select it as his standard because it has one of the defects complained of in the Post Office standard, *i.e.*, variations of the acidity of the liquid which may render the result doubtful.

A short, but important chapter is devoted to a consideration of the local attacks of the zinc in open circuits. He, like Sir Chas. Wheatstone did many years ago, finds it advantageous to use, instead of zinc, amalgamated on the surface only, solid amalgams of zinc. He finds that the cost of such amalgams, made up with zinc turnings of good quality is lower than the cost of surface-amalgamated zincs, which must often be re-coated at a great outlay for mercury and labour. The advantages of the solid amalgam are especially striking in long-continued experiments. M. Reynier recommends sulphuric acid made from sulphur as decidedly preferable to the ordinary quality made from pyrites, which inevitably contain certain impurities. Free nitric acid increases the wear and tear of the zinc, which, on the other hand, is greatly diminished by the addition of a little sulphate of ammonia.

Porous vessels and septa form the subject of another section. Animal membranes he considers of little practical value on account of the difficulty of procuring them of desired shapes and sizes, their deficient resistance to acids and alkalies, and their liability to the attacks of vermin, parchment-paper has almost entirely taken their place. Cells of unglazed earthenware have the defect of being too resistant.

The fifth chapter deals with the electromotive force of batteries of the Daniell class, that is, all elements with two liquids which reduce copper upon their positive electrode. In giving a table of the electromotive force resulting from several combinations of this kind, he remarks that in the arrangement with a saturated solution of sulphate of copper in the copper compartment, and with a solution of sulphate of zinc in the zinc department, the electromotive force remains approxi-

* Piles Electriques et Accumulateurs : Recherches Techniques.

mately fixed, and adds "it is with good right that the Post Office has chosen this combination as a standard." It may be asked whether the author does not somewhat contradict himself as he has said in his second chapter "the battery would have, with this salt (*i.e.*, sulphate of zinc) one of the defects which I object to in the Post Office standard, those variations of acidity which may cause us to doubt the exact value of the electromotive force of the couple."

He remarks that many of the values which he has obtained differ from those ascribed to Poggendorff, Joule, Regnault, and Wiedemann. "These discrepancies may, in part, spring from errors committed in the choice of coefficients selected for calculating the results of these physicists into volts. There are differences amounting to 12 per cent. in the value of electromotive forces between combinations apparently so similar that certain experimentalists have thought themselves entitled to assume them indifferently as units.

Next follows a most valuable table—never before printed—of electro-chemical equivalents.

The cost of the work furnished by hydro-electric batteries comes next under consideration. His method of determining this capital point has been to find first the theoretic cost, assuming the action to be perfect and the utilisation complete. He then obtains the approximate practical cost by multiplying the theoretic price by two factors. The former of these, or coefficient of physical utilisation, expresses the ratio between the electromotive force of the couple and the decline of the potential utilised. The second factor, or coefficient of chemical utilisation is the proportion between the weights of materials employed, and the weights usefully consumed.

The batteries which he has chosen for valuation are the Daniell, the chromic acid battery, and the new combinations of de Lalande and Chaperon. Of these the "verdigris" element—a modification of the Daniell—is the cheapest, and the de Lalande and Chaperon the dearest, its working cost being 6·37 francs per horse-power hourly. Concerning the batteries of Leclanché, Bunsen, Tommasi, &c., the author thinks that the chemical reactions effected in them are too little known to enable their working cost to be calculated.

After a note on the working of the Leclanché batteries used in the telephonic service at Paris the author passes on to accumulators, or secondary batteries. Here he enters with great care into the question of the use of accumulators in traction. We find as the result of his calculations the cost per horse-power hourly with accumulators is 1·29 franc, whilst with horses it is 2 francs. This would show an economy of 35 per cent. in favour of accumulators.

This work is illustrated with 51 figures, and is provided with a good index, a table of contents, and a bibliography of the subject. It will prove exceedingly interesting and useful to all persons engaged in the study of the practical applications of electricity.

Report on the Exhibits at the Crystal Palace Electrical Exhibition, 1882. By Ensign FRANK J. SPRAGUE, United States Navy. Washington: Government Printing Office.

This report is a most valuable and complete one, and reflects great credit upon its compiler. The latter has spared no pains to do his work thoroughly well; he has, in fact, practically written a treatise on electric lighting which puts to shame many recent publications on the subject. The account of the experimental work with gas engines is especially valuable, and it has brought to notice certain actions in these machines which were apparently unknown until the experiments were made. The report might certainly with advantage be republished in the form of a scientific treatise, so that its contents may become available to those interested in the general subject of lighting by electricity; although, indeed, the bulk of the information has already been published by us in some articles on the Crystal Palace Exhibition in the months of March and April last.

THE HISTORY OF PHOTOMETRY.*

PHOTOMETRY is a subject which has developed with the electric light. Formerly it did not appear to offer any great difficulties, and it has consequently been treated somewhat superficially in our text-books of science. For the electrician, photometry has a two-fold importance; the function of the photometer is, firstly, to show what quantity of light a certain lamp supplies, so that its economy may be judged; and, secondly, to demonstrate the relations between the light produced and the other forces at work in a given system of machines and lamps. It was only when this latter point became better understood that photometers began to engage the attention of the electrician.

The first photometric tests referred to in text-books of science generally, are those of Fizeau and Foucault, of 1843. It must, however, be borne in mind, that what these eminent French scientists originally measured is not that which really interests us at present in such experiments; the decomposition of an iodine and silver combination, by means of light from various sources, indicated the chemical intensity of the rays, but not the optical intensity. The surprisingly low chemical intensity of the lime-light caused MM. Fizeau and Foucault to repeat their experiments, in order to determine the optical energy; and the agreement of the new and old figures suggested to them that, for white light, the two determinations might practically be replaced by the one which is more convenient, that is, the chemical test. It is evident, however, and needs no further support in these days, when we photograph the invisible ultra violet spectrum, that chemical tests cannot be relied upon, and that photometers like Becquerel's electro-chemical actinometer, or Siemens's selenphotometer, cannot measure the illuminative power of a source of light, however perfect and ingenious they may be in other respects. We have still to depend upon the physiological action of the light rays upon the retina of our eye, untrustworthy as this may be, since different observers are not equally sensitive to the same degree, and even the same observer is not so at all times.

The photometrical researches of Th. W. Casselmann, of Marburg, are of interest for the electrician, because they included the electric light, because they were prior to those of Fizeau and Foucault, and because in them there was first introduced Bunsen's photometer, in favour of which Casselmann decided against Ritchie and Rumford.

No accurate tests appear to have taken place after that before 1855, when MM. Lacassagne and Thiers tried their electric lamps at Lyons. M. Edmond Becquerel reported on those trials to the Société d'Encouragement of Paris, and this report led to a contest between the interested parties, as Becquerel estimated the intensity at 350 candles, whilst the manufacturers claimed 600 and more. This contest was of importance, because the real point was the question of expense. Scarcely any tests of real scientific value were, however, undertaken before the Alliance magneto-electric machines in France, and those of Mr. Holmes and others in England, attracted attention. Then difficulties cropped up everywhere, and the main problem has not been solved up to the present day. Neither the French bec-carcel, nor the English standard candle, nor the German candle, can be considered as normal, as they are all variable; this is strikingly evidenced by the fact that the ratios between the different standards, as stated in hand-books, do not agree. Many proposals have been made; MM. Rüdorff and Methuen suggested that the middle part of a flame, as more steady than the flickering top and the lower zones, ought to be observed; Mr. Vernon Harcourt and others proposed to burn mixtures of air and normal gases, and the former gentleman exhibited a neat normal lamp of about three-candle power, at the Southport meeting of the British Association. But these devices were mostly too delicate and complicated, and Mr. Louis Schwendler, one of the many electricians whose deaths we have lately had to lament, perhaps made the most practical suggestion in once more drawing attention to Mr. J. W. Draper's idea of using a fine platinum wire, heated by a constant current. Schwendler's units are sheet platinum horseshoes of ·017 millimetre thick; but these again are open to objections, as we shall find. If we return to our historical abstract, we find M. Tresca, in 1876, experimenting with a Foucault photometer, a modification of Rumford's instrument, which is largely employed in France, and comprises a milk glass disc, whose two halves are illuminated by the lamp to be examined and the standard candle respectively. Tresca experienced difficulty from the different colours of the lights, and interposed tinted glasses before them. Very instructive were the tests at the South Foreland light-houses, conducted by Messrs. Tyndall and Douglas, and fully described in the Trinity House Report, 1876–77. The electric lights were compared to a powerful colza oil lamp, kept as nearly as possible constant at 722 standard candles; this comparison was effected by a Bunsen photometer, the colza lamp being again controlled with the help of a Sugg photometer. As the arc itself emits very little light while the greater part comes from the negative carbon, and a smaller amount from the positive, the necessity arose of taking, even with the two carbons vertically above one another, observations in various horizontal planes; M. Allard has further pointed out that even the various points of the vertical plane of the normal candle do not receive equal quantities of light. The report on his very extensive tests at the French lighthouses to the French Ministry ("Mémoire sur les Phares

* Abstract, in *Engineering*, of the Report of the Scientific Commission at the Münich Electrical Exhibition.

Electriques"), Paris, 1881, forms a very valuable contribution to the literature on photometry. M. Fontaine's observations on the Gramme machines and Serrin lamps, described in his "Eclairage à Electrique," 2nd edition, 1879, also deserve mention for their completeness. Both MM. Allard and Fontaine used Foucault's photometer, and suggested ways to arrive at mean values with very unsteady lamps; these proposals are, however, hardly of practical weight, nor could M. Allard's idea of verifying his figures, with the help of a Crookes' radiometer, contribute much to their corroboration, as this comes scarcely within the functions of a radiometer. Foucault's photometer was likewise employed when MM. Sautter, Lemmonier & Co., of Paris, were testing their photo-electric apparatus for military operations, the lamps being supplied with Colonel Mangin's aplanatic reflector; green glasses were also, in this case, interposed to equalise the colours.

A similar arrangement was adopted at Rouen in 1881, when, on behalf of the Société Industrielle, the systems of Jaclochkoff, Gramme, and Siemens were subjected to a series of comparative tests. Here, again, a Foucault photometer was used, together with the ordinary bec-carcel, and the silvered-glass mirror to make the rays parallel. The loss from reflection was averaged at 30 per cent.; the observations were made at various distances, and a determination was made of the radius of that horizontal plane, which received the same quantity of light as a normal candle could supply at a distance of about 4 m. This was a step in the right direction; the report, "Rapport general sur l'Eclairage Electrique des Quais de Rouen," 1881, shows curves drawn to indicate by their ordinates, the light falling upon the horizontal plane.

The municipality of Paris has for some years instituted annual tests of the Jablochkoff candles in the Avenue de l'Opera, which tests finally induced them to abandon those apparatus. The Jablochkoff candles shed their maximum illumination, of course, in the plane perpendicular to the line drawn through both candles; the minimum in this line was found to be 0·57 of the maximum; the mean intensity, however—not the mean between maximum and minimum—was equal to ·9 of the maximum, as the intensity curve proved to be of the shape of a figure 8, and not an ellipsis. It also transpired that the air was less transparent to the red light of the Jablochkoff candles than to the gas rays.

The well-known experiments at Chatham of 1879 and 1880 ought to have been mentioned before this. The apparatus comprised a Rumford photometer and an Argand burner of 40 candle-power, with a Sugg's regulator. Photographs were taken at the same moment of the front and sides of the carbons, and the illuminated areas calculated from these photographs. The average illumination of a point was further derived from these calculations, under the questionable assumption that the light was evenly distributed over the whole plane.

We have already spoken of the difficulty which was met with in comparing lights of different colours. The method of action of the ether vibrations, which excite our optic nerves and create the sensation of sight, is unknown to us; but we know that this function depends upon the wave lengths of the rays. M. Purkinje has shown that two coloured planes which appear equally light at a certain distance, seem to lose their light in a different ratio if further removed from the eye. Two lights of different colour are therefore incommensurable. Mr. Dietrich has recently, with more perfect apparatus, repeated the tests by means of which Fraunhofer attempted to determine the illuminative power of the various parts of the spectrum, whose lines he so assiduously studied and noted, without in the least conceiving their character and importance. Fraunhofer had only an oil lamp at his disposal, and, just as we should expect, he was wrong by about 9 per cent. with reference to the rays from the line D in the yellow, as here the two lights were most homogeneous, but wrong by 60 per cent. when analysing the rays from lines B, G, and H. Spectrophotometric observations, such as first proposed by Vierordt, Glan, and others, may be perfected to a high degree of comparative accuracy; if we arrange the two spectra to be compared, above one another, and divide both by vertical lines into bands of one and the same tint, we may indeed achieve very exact measurements. But this can only be executed in the laboratory, and not in ordinary practice, while, after all, it yields only comparative values for the various colours.

Tinted glasses have often been employed to produce rays of equal colour; but such interposition means loss. Captain Abney conceived the interesting idea of watching lights through a photographically prepared glass plate with a scale of darker and darker bands, through the darkest of which even the sun was not visible. But in the dark the eye gets slowly capable of distinguishing details which were at first quite indiscernible. Further researches, therefore, convinced Captain Abney that the ratio between red and blue in the same electric lamp, varied very considerably as the speed of the generator increased, so that the red rays, which originally were half as strong as the blue ones, finally possessed only one fourth of the intensity of the blue one, both, of course, increasing in intensity with the quicker revolutions. Profs. Ayrton and Perry followed Captain Abney in making two series of tests, choosing, however, red and green lights, instead of red and blue. The difficulty remains, however, how really to compare and reduce to unit measurements those two rows of figures. M. Crova (Comptes Rend. xciii. p. 512) went one step further in this direction. He watched the two half-discs of a Foucault photometer by means of two Nicol prisms, with their main sections vertical to one another, and between the pivots he put a quartz plate of 9 millimetres thickness. If the two lamps are placed in their proper positions both discs appear of a greenish-white tint, and may then easily be adjusted until equal illumination is attained. The theory of this apparatus is too complicated to be discussed here; the main point is that the quartz is designed to produce two broad interference bands towards the ends of the spectra; in the middle parts the intensity of the rays varies, but there must be one line at which the rays pass through the pivots without becoming weakened. This maximum of illumination is now, by adjusting the second pivot, to be fixed at those rays whose comparison would yield the same result as that of the total intensities. The apparatus is ingenious, but in seeking for the districts of equal illumination in the two spectra, it presumes that the spectro-photometer received equal amounts of light from both sources, which anticipates the solution of the problem.

The newer photometers of both M. Cornu and Profs. Ayrton and Perry permit measurements of strong electric lamps being taken in small rooms without the awkward necessity of removing powerful lamps to great distances to bring them into comparison with the standard candle. M. Cornu intercalates between the rays of both lights an achromatic lens whose active aperture may be widened or lessened with a micrometer screw, and thus varies the quantity of light falling upon the photometer. Apparatus of this kind have often been thought of; the star photometers of Steinheil and Herschel are based upon the same principle. Messrs. Ayrton and Perry, in their dispersion photometer, use a concave lens to decrease the intensity of the rays. No loss of light was supposed to occur through absorption in this concave lens if it were only thin enough; Mr. Voller, of Hamburg, has, however, taken exception to this assumption, and pronounced the possibility of losses of 10 per cent., and Messrs. Ayrton and Perry seem after to have silently admitted this source of error by introducing a plane parallel glass plate between the screen and the standard candle to weaken the intensity of the light standard. The losses through absorption in the air Profs. Ayrton and Perry observed to be strongest for green light. MM. Bouquer and Allard have further investigated the phenomena of absorption in air; the coefficients vary greatly with the conditions of the air, but they are sufficiently determined to show that in tests where the strong lamp is 50 metres distant from the screen, a loss of about 4 per cent. has to be taken into consideration.

We have finally to speak of the labours of the third section of the Congress at Paris in 1881. The candle found practically no advocate, although Dr. Werner Siemens declared that a good candle need not vary by more than 5 per cent. MM. Tochikoleff and Bède stood up for Schwendler's platinum unit, but M. Crova objected, because platinum had no constant molecular structure, and consequently no constant emissive power; small differences of temperature would further lead to inexact figures. M. Violle recommended the use, as a unit, of the quantity of light radiated by one square centimetre of platinum at melting point. MM. Werner Siemens and Cornu assented, but preferred silver. Sir William Siemens proposed an iridium wire under the influence of the unit of current. MM. Neujean and Flamache caused slight surprise by praising the magnesium and lime lights. For want of anything better, the old bec-carcel was finally left in office, although M. J. Dumas pronounced it too weak. The discussions on photometers were less warm. M. Bergè made the curious proposal to remove the lamp until a white screen would no longer be visible through a solution of the sulphate of copper ammonia. The great problem of what to do with reference to the various colours also remained unsettled. M. Allard suggested the creations of a blinking effect, as then all colours would dissolve into one uniform grey, and Dr. Gladstone proposed the employment of long distances across which the differences of colours would disappear. The proposal of M. Rousseau that for each lamp the equation of the intensity curve $J = f(a)$ should be calculated was warmly supported and accepted.*

THE ORGANISATION OF THE POST AND TELEGRAPH SERVICE IN FRANCE.

(*Continued from page* 44.)

Telephones.—We have been obliged to go deeply into the question of the establishment of telephonic systems. The conditions on which these concessions are granted in Paris and in the large towns, have been fixed by a decree dated the 26th June, 1879. It is worded as follows:—

Sec. 1.—The external system to be established by the Government Telegraph Department, exclusively at the expense of the licensees, who have to prove that they have obtained the necessary authority from Municipal Administrations and from proprietors, whose properties would have to support the wires, or would in any way be affected by those wires.

All damages which may be claimed for the erecting and maintaining of supports and wires, either on lease or in any other way, to be paid by the licensees.

The total amount of the cost of installation for material and labour to be refunded to the Administration, in proportion to the quantity of work done, on a statement made out by the Telegraph

* Since the date of this report the Paris Congress has decided that a surface of one square centimetre of melted platinum shall be the standard of light.

Service, whose estimates the licensees agree to accept beforehand.

The maintenance of this system to be guaranteed by the same service, on the same conditions.

As a guarantee of those payments, made under this double agreement, the licensees to deposit in the "Caisse des depôts et consignations," before obtaining their full license:

1. A sum of 20,000 francs to be held as a deposit there until the works of establishing the system are completely finished.

2. A sum of 5,000 francs to be held as a permanent deposit for the time of the lease. In case of non-payment of the amounts due by the licensees, in pursuance of the before-mentioned resolutions, those deposits to become the property of the State eight days after due notice be given to this effect, and the licensees to make up the difference to the above-mentioned amounts without any delay.

Sec. 2.—The State not to incur any responsibility, either as regards the execution of those works or the total or partial interruptions of the lines.

Sec. 3.—The licensees to look after the leading in of the wires into the interior of the houses to be connected, as well as the installation and organisation of the apparatus in the offices and in the connected buildings.

Sec. 4.—The apparatus used by the licensees to be first submitted for approval to the Minister of Posts and Telegraphs, without whose authority they may not subsequently be altered.

Sec. 5.—This grant to give the right to the licensees, if required, for interchange of correspondence, to put each of the buildings connected with the different central stations in direct communication, either with those stations or between themselves.

But in no other case shall this correspondence be made use of, other than for the personal requirements of the subscribers to the undertaking; any communication made by those subscribers for the benefit of outsiders being strictly prohibited.

Sec. 6.—The rates to be collected by means of subscriptions, and the other conditions of those subscriptions to be fixed by the Minister of Posts and Telegraphs, as well as any further modification in either of those.

The rates to be established on a uniform basis for all subscribers to the undertaking, the showing of any favour in these prices being strictly prohibited.

A reduced rent, however, to be allowed to the Public Government or Municipal buildings which may be served by the undertaking. This reduction to be fixed by the Minister of Posts and Telegraphs, and not to exceed one half of the rent charged to private people.

Sec. 7.—The working of the system to be subjected to the control of the State. For this purpose the officials of the telegraph service, nominated by the Minister, to have the right to enter at any time the central stations for such inspection.

Sec. 8.—The licensees to pay to the state, by way of rent for the telephone, an annuity calculated at the rate of 10 per cent. of the gross receipts of the undertaking; this annuity not to be less than 5,000 francs.

This minimum of 5,000 francs to apply to a whole year. For the first year the annuity to be reduced in proportion to the number of days elapsed before the first central station was opened for service.

Sec. 9.—To guarantee the payment of the sums due to the State, in virtue of the preceding article, as well as to cover it against any indemnity which it might have to claim for non-observance of these clauses, the licensees to deposit in the "Caisse des depôts et consignations," within the month of the issue of the licence, a security of 20,000 francs, which will be kept under this special condition during the whole continuance of the undertaking.

In case of non-payment of the sums due to the before-mentioned causes, this caution-money to become the property of the State, up to the amount due, and the licensees will be bound to pay up at once.

Sec. 10.—The license, granted at the risk of the licensees, on no account is to include any kind of privilege to their benefit; any other similar licenses may be granted without giving rise to any claim for damages, and the State maintains its right of working these systems under suitable conditions to itself.

The license to be personal and not to be transferred to others without the express written authority of the Minister of Posts and Telegraphs. It will be valid for five years, unless on subsequent renewal.

The license to become null and void:—

1. If the licensees should not have deposited within the specified time the securities fixed by paragraphs 1 and 9.

2. If they should not have opened their first central station within three months from the date of the license.

It may be withdrawn:—

1. In case the licensees, or the parties concerned, should become bankrupt.

2. In case that after eight days' notice the clauses and conditions of this grant shall not have been duly observed, principally as regards the sole use of the wires for the personal affairs of the subscribers.

The grant may be suspended in case of suspension of the service of ordinary private telegraphs, and for the whole time of such suspension.

In none of the cases before mentioned can the State be held responsible for any damages, either to the licensees or to the subscribers, or to third parties, however interested in the undertaking, such as capitalists, contractors, tradesmen and others; but the idemnity due, by virtue of paragraph 8, would by right be reduced in proportion to the term of the year which would still have to elapse at the time of the forfeiture, or in proportion to the time of suspension.

Sec. 11.—The Government can at any time buy up these grants, as well as the material employed in the undertaking, by means of payment of a sum to be fixed by mutual consent, or, in default, by experts.

Sec. 12.—The Government to have the right to purchase, at any time for its own use, apparatus similar to those used by the licensees, at prices arranged by mutual consent, or, in default, as valued by experts; any charges for patent rights being beforehand excluded from the elements of those prices.

Sec. 13.—Any disagreements relating to the interpretation, or to the execution of the clauses and conditions of this decree to be settled by the Administration.

Sec. 14.—Stamp and registration duties of these licences to be paid by the licensees.

Three petitions for concessions to organise telephonic systems, which have proved themselves to be possessed of sufficient capital, have been granted; the first on the 23rd July, 1879, the second on the 8th September, 1879, and the third on the 23rd September of the same year.

The holders of those licences have not been long in amalgamating their interests into one, by forming, on the 10th December, 1880, the "Société Générale des Téléphones."

This company has established systems in Paris, Lyons, Marseilles, Bordeaux, Nantes, Lille, Havre, Rouen, Saint-Pierre-les-Calais, Algiers and Oran.

The number of subscribers served by this company amounted, on the 31st March, 1884, in Paris, to 3,227, and in the other towns to 1,852, or a total of 5,079.

The length of the lines on the same date was, in Paris, 4,960 kilometres, and, in the other towns, 2,595 kilometres, or a total of 7,055 kilometres. The annuity of 10 per cent. on the gross receipts due to the State by the company, and which in 1880 had only produced 17,000 francs, amounted in 1881 to 55,937 francs; in 1882 to 142,637 francs; in 1883 to 217,146 francs.

By authorising private enterprise to organise the first telephonic systems, the Administration has not given up any of its rights. It has maintained the absolute control over those systems, and the right of buying up at any time those already at work.

It has not given any privileges, reserving to itself the right to grant other similar concessions, and to establish itself systems wherever they should be considered convenient.

The last of the granted concessions expires on the 23rd September, 1884.

It was considered necessary to put limitations to the working of the companies, so as not to make them compete with the telegraph service, the monopoly of which belongs to the State. It applies only to the towns mentioned before, and up to the district of the free delivery of telegrams in each of those towns.

Persons who wish to connect a residence situated outside of this district with the telephonic system, can do so by establishing a private telegraph line to such places.

A certain number have already taken advantage of this facility.

Now, it became indispensable to extend the telephonic communications outside of the towns. It is also necessary to open public offices in which the telephone can be put at the disposal even of non-subscribers, to correspond either with a subscriber or with another public station, and to allow telephonic communications to be established between neighbouring localities.

Trials of this kind made in other countries succeeded very well. The German Administration, availing itself more especially of the experiment made in France, has put up and worked the telephones itself; 36 important towns in the Empire have been provided by it with telephonic systems, and the number of subscribers amounted on the 1st November, 1883, to 5,245.

It is the same in Switzerland, where the Federal Council has authorised the formation only of one single private system; at present the telephones are worked direct by the State in seven towns, counting amongst them 1,884 subscribers.

The Post Office in England, whilst leaving to private companies the right of organising systems, has itself undertaken telephonic work in Plymouth, Cardiff, Newport, Leicester, Hull, Sunderland, and in a few more less important towns. Besides, Manchester and Liverpool, as well as Cardiff and Newport, are connected with each other by means of telegraph wires placed by the State at the disposal of the subscribers, and a similar communication will shortly be at work between Newcastle-on-Tyne and Sunderland.

As these different experiments were conclusive, it appeared to us that a trial by the French Administration to work the telephones would give the best results.

It was further indispensable to undertake, as a trial, the direct organisation by the State of telephonic systems, so as to have all the necessary elements for judgment as to what course should be taken in future.

It is on those grounds that a credit of 250,000 francs has been asked from the Chambers, and granted in 1882, to provide for the first cost of installation of the telephonic systems of the State.

The system adopted by the Administration is based on the reimbursement by the subscribers of the cost of first outlay, and the payment of a yearly subscription intended to cover entirely the working expenses and to pay off the cost of installation of the central station, the expense of which is borne by the State.

But so as not to tax the public with too heavy obligations from the beginning, the cost of installation may be paid off in four yearly instalments.

We must observe that the Société Générale des Tél'phones had selected the most important towns, where telephonic systems would very soon give good results. When we undertook these experiments, and as we wished to carry those out in other towns, we found that we had only a limited and not very favourable choice. However, the public has already appreciated the particularly advantageous conditions of the reduced rate of our subscriptions.

We have rapidly obtained 225 subscribers in Reims, 209 in Roubaix-Tourcoing, 104 in Troyes, and 40 in Saint-Quentin, and we are now occupied in establishing telephonic systems in other towns.

The systems in Reims and in Roubaix-Tourcoing were opened on the 1st April, 1883. The manner in which they work offer to the subscribers great advantages, especially by the installation of special "call-boxes," to allow of corresponding with the subscribers in any part of the town.

These "call-boxes" are at the same time in telephonic communication with the central station, either to forward messages to it, or to receive messages from it; a very quick dispatch of the service is thereby obtained.

The town of Reims, owing to these advantages, possesses now the French telephonic system, which counts the largest number of subscribers in proportion to its population, notwithstanding the recent date of the opening of the service.

There are in Reims 23 subscribers for every 10,000 inhabitants; whilst Calais and Saint-Pierre-les-Calais only count 22; Havre, 18; Paris, Lyons, Bordeaux, 14 each; Marseilles, 10; Nantes, 8; Rouen, Oran, 6 each; and Algiers 3.

We believe that the State, at any time, will be able to make excellent work of the telephonic service; this is proved by the success of the systems in Reims and Roubaix. But, at the same time, we are considering whether it would not be to its interest to adjourn the time when it has to undertake this charge for all the telephonic systems of the territory, and to devote to it a considerable capital; this is now a subject for our earnest consideration.

Note.—We read the following in *La Lumière Electrique*, of the 12th inst.:—

It appears that the Minister of Posts and Telegraphs has sent up to the Chamber the draft of a law, proposing to prolong for another five years the present concessions granted for telephonic systems, whilst reserving to the State the right of establishing such systems itself, or to grant to other companies competitive systems.

The Committee of the Chamber, appointed to examine this draft, have decided to request the Minister to withdraw it and to have it modified, because of it not being expounded quite sufficiently.

(To be continued.)

COMPARISON OF THE TRANSMISSION OF FORCE BY ELECTRICITY AS COMPARED WITH THE OTHER MOST COMMON MECHANICAL TRANSMISSIONS.

By A. BERINGER.

If we admit that the local conditions are equally favourable to the four systems (viz., electricity, water under pressure, compressed air and telo-dynamic cables), that is to say, if we set on one side particular considerations which may render one or the other system more suitable in a given case, the comparison of prices shows that electricity and telo-dynamic cables are the most favourable agents for the transmission of power. Between these two we must choose the cable as effecting the cheaper transmission up to a distance of 1 kilometre, but for greater distances electricity is preferable.

We note, in passing, the interesting result that a hydraulic motive power transmitted by electricity to a distance of 20 kilometres costs less than the same power produced on the spot by a large improved steam-engine, even if we calculate the water-power at 0·03 franc per horse-power hourly. It follows that a powerful waterfall will supply, within a radius of four leagues, power cheaper than that produced by steam-engines of 100—200 horse-power, and within a far wider radius it will compete advantageously with small steam-engines, or with gas.

Although cables are very suitable for distributing power in the country to a few separate places, they are quite out of the question when it is required to effect unlimited sub-divisions, *e.g.*, in a distribution of power from house to house in a town. In this case the three other systems remain alone in the field.

For distances of less than 1 kilometre electricity has only the advantage of a few centimes over air and water, but its advantage increases for longer distances. Thus the hourly cost per horse-power for ½ kilometre is 0·24 franc, for 1 kilometre 0·25 franc, and for 12 kilometres 0·37 franc, whilst water and air reach this price for 1½ to 2 kilometres.

Transmissions by water and air are therefore far surpassed by electric transmission, and if we wish to produce power by steam in a central establishment and distribute it from house to house within a radius of 10 kilometres electricity alone could furnish an economical solution of the problem.

We must here remark that such a distribution of power can only be, for the present, useful in the small trades, for if more than 10 horse-power is required a special motor is more advantageous.

If we divide the region to be supplied with power into squares of 8 to 10 kilometres a side, having each a large steam-motor, we may supply a horse power at 0·25 franc hourly as against 0·32 franc, which would be the cost of a gas-motor, which is a considerable economy in favour of electricity.

There are numerous cases where local conditions render it impossible to set up a motor at the place where the power is required, and only certain systems of transmission can here be employed. Thus in mining and tunnelling, air and electricity only are applicable, and if we suppose that there is need for 10 horse-power we see, on comparing the price of this power transmitted by compressed air and by electricity, that the advantage is greatly in favour of the latter. For more considerable transmissions of power the prices agree fairly well up to 5 kilometres, but beyond this the advantage of electricity becomes very decided. In addition, an electric transmission is more easily established than the conduction of compressed air, and it is much easier to extend a system of the first kind than of the second.

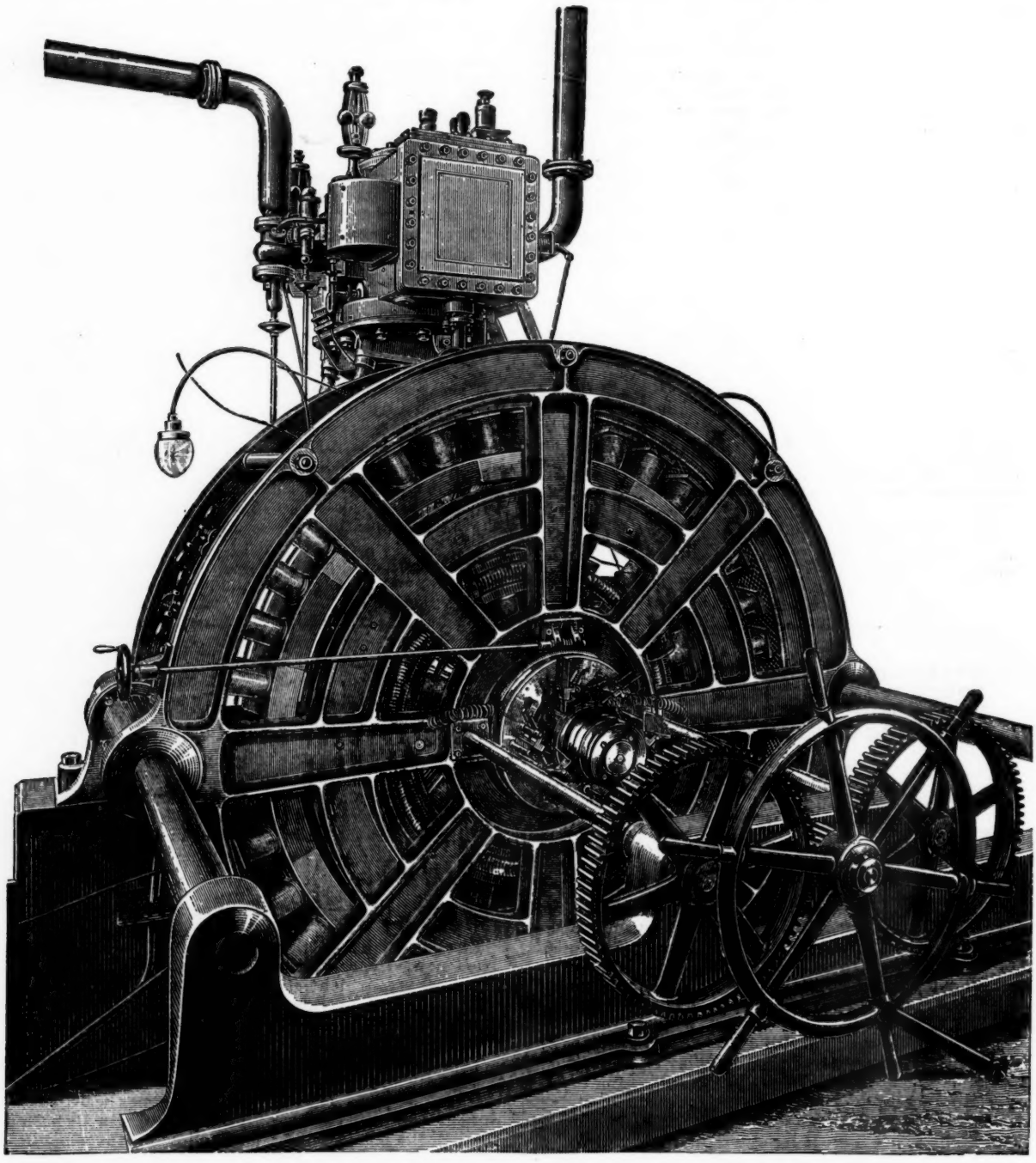
Certainly boring-machines with compressed air often suffice for ventilation, whilst an electric transmission of power requires to be accompanied by especial appliances for this purpose. Still the advantages of electricity as regards convenience and economy are so great that we cannot hesitate to employ it whenever there is no fear that sparks from the dynamo machines may occasion explosions, especially as electricity can at the same time serve for lighting.

In conclusion, in cases were telo-dynamic cables are not applicable electric transmission is much preferable to transmission by water or compressed air. It is more economical than gas-motors for transmissions up to 5 kilometres. Where transmission by cable is applicable it is the more economical up to 1 kilometre. From 1 to 5 kilometres electricity has the advantage.—*Revue des Mines.*

Electric Light Wires as Lightning Conductors.—The new drill hall of the State University at Minneapolis, which stands on an eminence, was recently struck by lightning during the progress of a musical festival, A workman on the roof had his shoe torn off, and his leg badly burned; another person in proximity to one of the masts was temporarily paralysed; and two or three ladies fainted; but that was all the damage sustained. A loud report was heard, as if of heavy ordnance, balls of fires were distinctly seen through the large skylight, and following the electric wires away from the building. Subsequent examination showed that the lightning first struck the flag staff surmounting the door, thence pierced an oaken beam to which the staff was fastened, the splinters, or the concussion, breaking the glass in the skylight. An iron rod conducted the fluid to the network of electric wires below, where the charge was divided, a portion being harmlessly distributed over the general circuit, and the remainder shattering several electric masts near the building. A metallic ball surmounting the flag staff is supposed to have attracted the lightning.

GANZ'S ELECTRIC GENERATOR.

THE enormous electric generator shown by Messrs. Ganz and Co., of Buda-Pesth, at the Vienna Exhibition, has now been permanently erected, says *Engineering*, at the Central Station at the Hungarian States Railway at Buda-Pesth. It is to be employed to supply current for 70 arc and 600 incandescence lamps, and will form



part of one of the most important and interesting installations in Austria. The machine itself, and the inverted compound engine by which it is driven, are shown by the illustration, a block having been kindly placed at our disposal by Messrs. Ganz and Co.; the two are combined on one bed-plate, and the moving part of the generator forms the fly-wheel of the engine.

The currents are alternating, and therefore the field-magnets need to be separately excited. Consequently the machine consists of two separate parts, viz., an alternate current generator and an exciting dynamo, both mounted concentrically on the same shaft. The armature of the main generator is composed of a wire drum, on the inside of which there are mounted 36 induction coils, in the manner adopted by Messrs. Ganz and Co., and which is shown in fig. 2. These are wound with wires of 3·8 mm. (·150 in.) diameter. The 36 field-magnets rotating inside the armature coils form a fly-wheel 8 ft. 2½ in. in diameter and 18 in. wide. The fixed magnets are wound with wire ·138 in. in diameter.

The exciting machine is a six-poled Gramme ring of 3 ft. 11 in. mean diameter, revolving within 12 pairs of field-magnets. The ring is wound with wire ·98 in. in diameter, and the magnets with wire ·138 in. in diameter. The commutator is 11·8 in. in diameter, and consists of 180 sectors.

A noticeable feature of this machine is that the whole of the fixed parts, that is, the induction coils of the alternate current machine and the field-magnets of the dynamo, are removable sideways to such an extent that a man may enter for the purpose of making repairs, though it is scarcely likely that this provision will be needed. To this end the fixed parts are mounted upon two stout horizontal bars, along which they can be drawn by two screws geared together and to a hand-wheel. By the aid of this arrangement one man can perform the work of removing the drum in a few minutes.

FIG. 2.

The following are the electrical measurements in connection with this machine :—

Resistance of 36 induction coils in parallel circuit	0·0039 ohms.
Resistance of 1,200 lamps and leads ...	0·038 „
„ field magnets of alternate current machine	0·44 „
Resistance of Gramme ring	0·165 „
„ field magnets of dynamo ...	0·24 „
Number of revolutions	180 per min.
Difference of potential at terminals of alternate current machine	57·6 volts.
Difference of potential at terminals of exciter	36·4 „
Current in alternate current machine ...	1516 ampères
„ dynamo	88·8 „
Watts of alternate current	96,297
„ exciting current	6,663
„ in lamp circuit	87,330
Electrical efficiency	85 per cent.

The weight of the machine is about 15 tons. It was designed and constructed in the short space of three and a-half months, and during the time of the exhibition was employed without any interruption to feed 900 Swan lamps of 20 candle-power each in the theatre, and about 300 others at the makers' stands.

ELECTRO-DYNAMICS.

BY JOHN W. NYSTROM.*

THE object of this paper is to criticise the electro-dynamics advanced by Count Du Moncel in his work on "Electricity as a Motive Power," page 297, English edition, and to show the confusion in which that subject is yet involved.

The Count Du Moncel gives three formulas on page 299, intended to express the quantity of work accomplished by an electric current, namely, as follows :—

$$K = R I^2 \qquad 1.$$

$$K = \frac{E^2}{R}. \qquad 2.$$

$$K = E I. \qquad 3.$$

K = work expressed in kilogrammetres.
R = resistance in the conductor expressed in ohms.
I = intensity of current expressed in ampères.
E = electromotive force expressed in volts.

No formulas can express quantity of work without representing the three simple elements—*force, velocity* and *time*, and as the time is wanting in Count Du Moncel's formulas, they cannot express work.

In the simplest formula for work, namely, $K = F S$, or the product of force and space, the time is included in the space S, which is the product of velocity and time. No work can be accomplished without time.

Work is transformed into power by eliminating the time, and the power is thus expressed "work per unit of time," and therefore no work can be transformed into power without dividing it with the time in which it is accomplished, but the Count divides work by the acceleratrix of gravity, and calls the quotient *power*, namely, as follows :

$$P = \frac{R I^2}{g}. \qquad 4.$$

$$P = \frac{E^2}{g R}. \qquad 5.$$

$$P = \frac{E I}{g}. \qquad 6.$$

P = power in effects, which is expressed in kilogrammetres per second.

To divide work with the constant acceleratrix of gravity $g = 9{\cdot}81$ meters per second, which is velocity, will give a quotient of momentum of time, F T, when a force, F, acts for a time, T, upon a mass free to move. Therefore, the formulas 4, 5 and 6 cannot express power, or the work done per unit of time, when formulas 1, 2 and 3 mean work. It appears that the first three formulas mean *power*, which, multiplied by time T seconds, will give work.

The term *intensity* of current is evidently intended to mean a definite physical quantity, which should have a definite unit of measure, but *intensity* is applied to heat, light, and other phenomena without a definite meaning.

It is evident from the formulas, and also from the mode of measuring *intensity* of current by a galvanometer, that *intensity* means velocity of the electric current, and can, consequently, be expressed by any unit of length per unit of time. *Ampère* is the unit of measure of *intensity* of current, which can be expressed by a unit of velocity. The present value of one *Ampère* is, or should be, a velocity of 1,000 kilometres per second. Therefore the term *intensity* should be abolished in that connection, and call it what it really is, namely, *velocity* of current, and denote the same with V instead of I, which would make the expression intelligible and definite.

Electromotive force is an expression of a definite physical quantity, which can be measured by any unit of weight, but the unit *volt* does not not convey an idea of a definite unit of weight or force. The electromotive force of one *volt* is a weight or force of about one milligram. The term *volt* should therefore be abolished in that connection, and be called what it really is, namely, *milligram*, and the electromotive force should be denoted by F, which means force. These proposed changes would make the subject intelligible and definite, like in mechanics, where we have the well-known physical element *force, velocity* and *time*, the combination of which, give the functions *power, space* and *work*.

The old and new forms of electro-dynamics would compare as follows :—

	Old form.		*New form.*	
Power.	$P = \frac{R I^2}{g}.$	1.	$P = V^2.$	1.
	$P = \frac{E^2}{g R}.$	2.	$P = \frac{F^2}{R}.$	2.
	$P = \frac{E I}{g}.$	3.	$P = F V.$	3.
Work.	$K = R I^2.$	4.	$K = R V^2 T.$	4.
	$K = \frac{E^2}{R}.$	5.	$K = \frac{F^2 T}{R}.$	5.
	$K = E I.$	6.	$K = F V T.$	6.

* Read before the Electrical Section of the Franklin Institute, June 13th, 1884.

	Old Form.		*New Form.*	
Resistance.	$R = \frac{E}{I}$.	7.	$R = \frac{F}{V}$.	7.
	$R = \frac{g P}{I^2}$.	8.	$R = \frac{P}{V^2}$	8.
	$R = \frac{E^2}{g P}$.	9.	$R = \frac{F^2}{P}$.	9.
Electro-motive force.	$E = R I$.	10.	$F = R V$.	10.
	$E = \sqrt{g R P}$.	11.	$F = \sqrt{P R}$.	11.
	$E = \frac{g P}{I}$.	12.	$F = \frac{P}{V}$.	12.
Velocity of current.	$I = \frac{E}{R}$.	13.	$V = \frac{F}{R}$.	13.
	$I = \sqrt{\frac{g P}{R}}$.	14.	$V = \sqrt{\frac{P}{R}}$.	14.
	$I = \frac{g P}{E}$.	15.	$V = \frac{P}{F}$.	15.
Time of operation in seconds	$T = \frac{K}{R V^2}$.	16.		
	$T = \frac{K R}{F^2}$.	17.		
	$T = \frac{K}{F V}$.	18.		

P = power in effects, which is expressed by kilogrammetres per second.
R = resistance of conductor in ohms.
E = F, the electromotive force expressed in milligrams.
I = V, the velocity of the electric current in thousands of kilometres per second; that is, when V = 1, the velocity is 1,000 kilometres per second.
T = time of operation in seconds.
K = work in kilogrammetres.

There are 75 French effects per horse-power.

There is a discrepancy between the old and new formulas for power, which is caused by Count Du Moncel dividing the work by the acceleratrix, *g*, and calling the quotient *power*. Therefore, his formulas for work do not agree with his formulas for *power*.

The new form gives the *power* 10 times greater than the old form, on account of the unit of electromotive force being assumed to be one milligram, and the unit of *velocity* 1,000 kilometres per second, which ought to be the units of these quantities.

Comparison of French and English units of power and work.

English.		French.	
Effects P.	Horse-power HP.	Effects P.	Horse-power HP.
1	0·001818	0·1382	0·00184
550	1	76·2	1·0136
7·2334	0·00178	1	0·01333
542·47	0·9863	75	1

The numbers which express units of power are equal to the numbers which express units of work done per unit of time, but the quantities, power and work, are different from one another, as explained above.

I beg leave to repeat what I have stated many times within the last 20 years, namely, that the science of electricity can never be cleared up before the electrical savants learn to understand dynamics. The greatest difficulty they have to encounter appears to be the distinction between *force*, *power*, and *work*, which quantities they now confound with one another.

The difference between *force*, *power*, and *work* is respectively the same as that between *length*, *surface* and *volume*.

NOTES.

Electric Lighting.—So satisfied is the Wolverhampton Electric Light, Storage, and Engineering Company with the number of orders which it has received, that the proprietors have determined to throw over the branches of the hardware trade in which they were engaged, and devote themselves exclusively to the electric light business. With this object they have sold off their old plant and stock, and will fit up their premises wholly for the new industry. The blast furnaces at Spring Vale, near Wolverhampton, of Mr. Alfred Hickman, are having the electric light laid on by the company.

Some few weeks ago, states the New York *Electrical Review*, Messrs. Goff and Downs, president and vice-president of the American Electric and Illuminating Company, of Boston, visited Saratoga for the purpose of looking the field over, with a view to establishing a central lighting station there under the American or Thomson-Houston system of electric lighting. The inducements held out were so favourable that the company decided upon building a station, and when steam was turned on for a trial test, a more complete success could not have been desired. Hundreds of visitors from all parts of the country universally pronounced them the best electric lights they had ever seen. The hotels and business houses are delighted with the new light, and the company will meet with splendid success.

One of the largest manufactories of gunpowder in Germany has been entirely lighted by means of the Bernstein incandescent lamp.

The Town Council of Hull has resolved that the borough engineer shall obtain tenders for and report upon the best means of lighting the public lamps and town hall, within the area up to the present lighted by electricity by Messrs. Siemens Brothers, whose contract has been rescinded.

We omitted to state, in our note last week on the lighting up of "Larard's Still" in Manchester, that the work was carried out by Mr. F. D'A. Goold, who, in consequence of increasing business, has just opened some new premises in that town called the Volta Electrical Works.

On the 15th inst., at Walham Green, the committee of the *fête* of the Butchers' Charitable Institute introduced 6 powerful arc lights and 15 incandescent 20-C.P. Woodhouse and Rawson lamps, for the purpose of illuminating the grounds, ball marquee, and tents. The introduction of these lights not only gave the utmost satisfaction to the committee, but contributed in no small degree to the success achieved; the steadiness and brilliancy of the lights giving much pleasure to all present. The installation consisted of an 8 horse-power portable engine, with separate dynamos for arc and incandescent circuit. The work was carried out by Messrs. Woodhouse and Rawson.

We understand that the very large dynamo constructed for the late Richard Werdermann by Messrs. Emmerson and Murgatroyd, of Stockport, is to be disposed of. Any of our readers desirous of further information respecting the machine or the patent for same, can apply to Mr. A. Werdermann, 13, Princes Street, London, W.

The Telephone in Edinburgh.—The subscribers to the exchange at Edinburgh, which embraces the districts of Edinburgh, Leith, Newhaven, Trinity, and Granton, number 290, who make, on an average, 1,480 calls per day. A contributor to the *Edinburgh Courant* has worked out a calculation, showing that the cost of each message is rather more than nine-tenths of a penny, the rate of subscription being £15 per annum. The utility of the telephone in Edinburgh has lately been greatly increased by the opening of a trunk line to Glasgow, by means of which any subscriber to the Edinburgh exchange may be connected with any of the subscribers—and they number about

700—to the Glasgow exchange. The additional charge for this service varies from £50 to £25 per annum, according to the facilities required. The whole of this rental, owing to the conditions imposed by the Post Office, is paid over to the Goverment, the telephone company working the service free of charge for the benefit of its subscribers. There are in all sixteen subscribers to this Glasgow line—three in Edinburgh, five in Leith, and eight in Glasgow—and if the departmental regulations were relaxed the number would, no doubt, be largely increased. As trunk wires also exist from Glasgow to Paisley and Greenock, Edinburgh subscribers may likewise communicate with the subscribers to the Paisley and Greenock exchanges upon paying the Government charge. It is an interesting fact that the trunk wire between Edinburgh and Glasgow is the longest telephonic line in the United Kingdom. The communications passing over it sometimes number 50 in one day. The total length of wire owned by the company exceeds 236 miles. An application is now before the Town Council for permission to lay the wires on one of the most crowded routes underground.

The Post Office and the Telephone.—The *Western Morning News* says :—"We do not think the Government sufficiently estimates the damage which is being done to its reputation by the action of the postal authorities with regard to the telephone. When it is seen that year after year the Post Office is acting as a deadweight on the development of the telephone, is repressing its extension to the purposes of commercial life and discouraging inventors, it is obvious that such procedure becomes vastly irritating to business men. In Plymouth, Devonport, and Stonehouse, three years ago, there were 150 residents, each of whom could speak to the other through a telephone exchange. But official pique on the part of the Post Office put a stop to this, and established a so-called Post Office exchange. The number of members has never exceeded 46, it has now fallen back to 42, and several other subscribers have given notice to leave unless the numbers are so increased as to make the exchange really worthy of the name. But for the Postmaster-General's veto a real and useful exchange might be established in the three towns next week, at a subscription far less than that which the Post Office demands. The Liberal Government protests against obstruction in Parliament, but itself practises it all over the country."

The Telephone in Thunderstorms.—On Thursday morning, at Sunderland, a clerk of Austin and Son was struck by lightning while listening to a telephonic message and had to be conveyed to the infirmary.

Telegraph Revenue.—The receipts on the Telegraph Service from April 1st to July 19th, 1884, were £520,000, against £515,000 from April 1st to July 21st, 1883.

The New Atlantic Cable.—The cable steamship *Faraday*, engaged in laying the Bennett-Mackay cable has, a daily contemporary states, paid out as far as the coast of Nova Scotia, but the completion of the work is delayed by fogs.

Extension of the Telegraph in Siam.—The construction of a telegraph line from Bangkok to Zimmay, and thence afterwards to Burmah, has been sanctioned, and will be pushed on and completed in the next dry season.

Overhead Wires.—Sir A. Gordon asked the Secretary to the Local Government Board, in the House of Commons on Tuesday, whether Her Majesty's Government would next year introduce a bill to give to the local authorities of the metropolis and other towns such a power of inspection and control over the construction and maintenance of overhead telegraphic wires as would tend to protect the public using the streets from the dangers incident to such aerial fabrics. Mr. G. Russell: The Government cannot at present give any undertaking as to bills to be introduced by them next session. There would probably be an advantage in the appointment of a select committee to inquire into the subject of overhead telegraphic wires, and the question whether such a committee shall be moved for next session will be considered.

Sir H. Tyler gave notice to ask the Home Secretary whether he was aware that a number of overhead wires now existed in the Metropolis, of which about 230 were between the Royal Exchange and St. Michael's Church, Cornhill, and 200 in the vicinity of the Mansion House, Queen Street, and Queen Victoria Street, ; and whether, having regard to the danger of such overhead wires in the case of a high wind, he did not think that the time had arrived when some steps should be taken to deal with the question.

Mr. J. Russell Endean, writing to the *Times*, says :—"After the judgments recently pronounced in the Wandsworth and in the Bristol cases on the power of local authorities to control the wires of telegraph and telephone companies, the St. Marylebone Vestry withdrew the action it had commenced against the Globe Telephone Company for an injunction, on the ground that, for all purposes desired by the Government, the vestry considers the local authorities have now ascertained in the law courts, after 'a well-considered and unanimous judgment,' that there are no existing legal powers by which they can exercise such control. The united vestries of St. Marylebone and St. James, Westminster, have therefore resolved to memorialise the Government to introduce at the earliest possible moment a bill by which all control over the wires of telegraph and telephone companies through the streets of the capital shall be placed in the hands of the local authorities ; and, further, these vestries have invited the other vestries and district boards of London to adopt the same course. When the deputation on this subject recently waited on the President of the Local Government Board, he hinted that if legislation were proved to be necessary the Government would not hesitate to legislate, but the power of control would most probably be placed in the hands of some central authority, such as the Metropolitan Board of Works, and would not be intrusted to the local authorities. I venture to think such a deprivation of control as this implies will not be to deal justly with these authorities. At present all matters connected with the streets and thoroughfares are administered by vestries and district boards, and why these wires should be made an exception I am at a loss to conceive. I would, therefore, suggest that all wires in London in the public thoroughfares should be controlled by the local authorities of the parishes through which they are conveyed ; that, on any question or dispute arising between the parish authority and a company, either party should have power to appeal to the Metropolitan Board of Works for settlement of the matter in dispute, and that the decision of the said board shall be final, and shall not admit of any further appeal. This would prevent useless expenditure in law courts, would meet every requirement that could possibly arise, and would thus confer upon the local authorities the power with which they have just given such conclusive evidence they are fully competent to deal."

Electrical Tell-tales.—Messrs. Harrison, Cox-Walker and Co., have been requested to supply a second electric tell-tale of their special design and construction to the County Asylum, Lancaster, at which place they fixed one a year or two ago. This is the best form of testimonial as to the satisfactory way in which the apparatus performs its work. The present order is for recording from 34 stations ; the tell-tale previously supplied was for 20 stations, or wards, in electric connection with the recording apparatus.

The Lalande-Chaperon Battery.—We would refer those of our readers who desire still further information concerning the efficiency of this battery, to a paragraph near the end of our review of M. Reynier's new book on Galvanic Batteries and Accumulators.

An Electric Tramway.—Mr. M. Holroyd Smith, engineer, of Halifax, has recently been engaged upon the task of applying electricity to tramway purposes, and a few days ago he gave an exhibition of the results of his labours. A temporary line of the ordinary gauge (4 ft. 8½ in.), and about 100 yards in length, had been laid down, and a car capable of accommodating about 20 persons stood on the metals. The current was supplied in the first instance by a large dynamo machine, driven by steam power. In the middle of the tramway track was a third rail with a narrow slot or groove, below which were two half tubes of copper, about three inches apart, forming the electric conductor. Within the conductor was placed the collector. The collector moved as the car moved, conveying the electric current to the motor beneath the floor of the car; and the motor, as it revolved, turned the car wheels. The collector consists, practically, of two small grooved rollers. The frame holding them has knuckle joints, actuated by springs, the effect of which is to keep the rollers constantly pressing against the sides of the conductor, and a good contact is always maintained. From the collector the electric current is carried by two insulated copper wires to the motor. The motor is of the usual pattern, and revolves at a high velocity. The power which it exerts is brought to bear upon the wheels of the car through the medium of invert wheels, in box gearing, so that the proper speed may be obtained. The wheels are fitted with differential gearing to enable the car to be taken round curves, and for hilly districts it would have a means of ascending steep gradients. The arrangement for steep roads consists, practically, of a large centre wheel running on the middle rail. To guard against the groove filling with dirt a channel would be made several inches below the metals, and at various distances sump holes would be dug. The wheels of the collector would thus regularly clear out refuse into the channel below, and this in turn would be washed into the sump holes, whence it would be easy of removal. Another advantage claimed for the principle is that the car runs as well when the metals are wet as in dry weather, and a shower or two during the trial tested this. The turning of a small handle set the car in motion. The speed varied from six to 12 miles an hour; had the track been larger a still higher speed could have been attained. The car was under perfect control, and, with the assistance of the brake, could be stopped very quickly. To move one car would require about 2½-horse power, and Mr. Smith estimates that the cost per car per mile would be about 2d., whereas now the average cost of running tramcars is said to be 10½d. In the event of the system being adopted for towns there would require to be central stations, one such station serving a distance of about three miles. Of the cost Mr. Smith speaks quite confidently. The system will probably be tried in Southport, and Mr. Smith has also been requested to furnish a small tramway for the Winter Gardens, Blackpool.

The Philadelphia Exhibition.—The buildings for this International Exhibition may now be looked upon as practically completed. Applications are still being made for space, and we would again remind intending British exhibitors who have not yet completed their arrangements, that every information on the subject may be learned from the representative of the Franklin Institute, Mr. Jerome Carty, at the 1st Avenue Hotel, High Holborn. Edison intends to show a 30-ton dynamo, and a notice has been issued advising sightseers not to approach it too closely. The United States Electric Light Company will make a great display, and, it is said, will endeavour to outdo Edison. We doubt not but that the Exhibition will be as great a success as its most ardent supporters can desire.

Dissolution of Partnership.—The partnership subsisting between Josiah Latimer Clark and John Muirhead, manufacturing electrical engineers, 23, Regency Street, Westminster, and Northumberland Works, Millwall, has been dissolved as from October 31st, 1883.

Primary Batteries for Electric Lighting.—A writer, signing himself "Galvanoplast," replies thus to "Electrode," a correspondent of the *Mechanical World*, who sought information on the subject of electric lighting by primary batteries:—"I suppose I ought to recommend a suitable battery, but having had some experience with many kinds for the purpose I dread the result. If, however, "Electrode" has a deep and well-filled pocket, an angelic temper, and is not disgusted when his hands are stained, his clothing ruined, and there is a lot of 'bye product' to be disposed of and no market for it—I may suggest a modification of the Fuller battery. The porous cell is charged with one part 'killed' spirits of salts to two of water. The outer cell is packed with two or three carbon rods as conductors, and the space filled in with broken carbon; then pour into the outer cell a mixture of saturated solution of bichromate of potash three parts, hydrochloric acid one part. . . . The ordinary form of bichromate of potash battery is altogether unsuitable to the generation of current for supplying electric lamps, and for all other work demanding a constant supply, because the liquid is not able to separate and absorb the hydrogen on the negative plate fast enough to ensure a steady and constant supply of current. The strength falls off rapidly, because hydrogen begins to cover the carbon plates of the battery as soon as the circuit is closed, and the film thus formed on the plates soon stops back the current. This fault has been mitigated by causing the plates to move whilst at work, by causing the liquid to move over the plates, and by the use of corrugated plates. But single fluid cells are not nearly so constant in action as those wherein two solutions are employed in separate compartments separated by a porous diaphragm. Among the best of these, using bichromate of potash in solution, will be found Dale's granule battery, six cells in series to light up a 5-candle lamp."

Underground Wires.—Mr. David Brooks, manager of the Electrical Construction and Maintenance Company of Philadelphia, writing to the city authorities of Pittsburgh, says:—"During the past year I have laid some 2,000 miles of wires in this city. We have used the telephone and telegraph on these wires, drawn in the same pipe, since July 1, without a moment's interruption. There is no cross talk, calling up other bells, disagreeable rattling, annoyance, or disappointment. Four years ago I laid four miles of pipe containing 40 conductors in the City of London, England. A letter from a person in charge of those wires, dated March 31, refers to that work in the following words: 'I am glad to report that the 40 wire cable at Clapham is working well yet.' He states that the Post Office department has asked Parliament for an appropriation sufficient to lay 200 miles of pipes. I will undertake to lay in the streets of Pittsburgh sufficient wires to accommodate all the telegraph and telephone companies so that they need not be obliged to use a single pole. I will guarantee these wires to work in such a manner as to reduce their complaints of interruption at least twenty-fold, and I will not charge them for the use of those wires but half what they now charge their customers."

The American Underground Wire Bill.—Representatives of several telegraph, telephone, and electric light companies recently had a conference with the Mayor of Brooklyn, when the impossibility of putting the wires underground, and of complying with the recent law passed on the subject, was urged. After the conference the Mayor said he was not able to see any way to literally comply with the law, even though the question of expense were left out altogether.

Drawbaugh Interests Capitalised.—The certificate of incorporation of the Drawbaugh Telephone and Telegraph Company, of Canada, was filed on July 3, in New York. The capital stock is fixed at $1,000,000. The lines of the company are to run from New York to Albany, Buffalo, Windsor, Ont., Hamilton, Toronto

and Montreal; then to begin again at Albany, to run to Rouse's Point, N.Y., Quebec, Halifax, and thence to the different states and territories of the United States and Canada, and across any other countries of the western hemisphere.

Thinness of Wire.—Claim has recently been made for having produced platinum wire of extreme thinness; but that this is no new thing is demonstrated by the following contribution to the *Scientific American*:—"Dr. Wollaston published in 1813—Philos. Trans.—an account of his making the wire $\frac{1}{18000}$ in. diameter. Mr. E. W. Arms has, since the fall of 1876, handled large quantities of it, as shown in hundreds of transits and levels now in use. The size ordinarily used for field transits is platinum wire of 0·003 in., covered with silver to 0·1 in.; this drawn to 0·003 in. will leave the platinum when the silver is dissolved off to be 0·00009. This wire will sustain a weight of four grains, or a ball of wax the size of a pea."

Storage of Electricity.—In allusion to this subject in his recent annual address, Mr. Henry G. Morris, retiring president of the Engineers' Club of Philadelphia, said:—"It is worthy of note that no progress is evidenced, in this country at least, of the principle of storing or accumulating electricity by the Faure, Planté, or any other process. On the contrary, the attention of our engineers appears to be directed in the opposite direction, looking to improvements which shall give to the arc and incandescent lights, without the intervention of a storage battery, many of the properties claimed for the lamps lighted from an accumulator."

A New Scheme of Post-Office Appointments.—A Glasgow daily contemporary says:—"I hear on good authority that the Postmaster-General is contemplating the introduction of a new scheme of appointments into the Postal and Telegraph service. At present good conduct, with length of service and ability combined, are the necessary qualifications, but under the new scheme no qualification will be necessary other than a strong recommendation from some influential person. Lately several appointments have been made under this system, and these have proved so satisfactory that there is every likelihood of their being extended. This is hardly likely to be received with much favour by the general body of clerks, as it will stop all higher promotions. It is to be hoped, then, that Mr. Fawcett will consider his position well before finally deciding to take this step, which will prove so palpable an injustice to all!!"

The Exhibition at Pesth.—The Secretary of State for Foreign Affairs has received a note from the Austro-Hungarian Ambassador respecting the facilities which will be granted to goods sent to the Exhibition which is to be held at Buda-Pesth in 1885. The Austrian and the Hungarian railway companies, the Danube Steam Navigation Company, and the Advia Navigation Company, will carry such goods at reduced rates. The Austro-Hungarian Lloyd has also made certain alterations in its rates for the same goods, and various railway companies in Germany, Holland, France and Russia have agreed, under certain conditions, to carry back, gratis, any goods not sold at the close of the Exhibition. The Finance Ministry of Hungary has also granted various Customs facilities for foreign goods destined for the Exhibition. The Governments of Germany, Holland, Italy, Belgium, France, and the United States of North America have consented to readmit, free of duty, goods which are brought back unsold from the Exhibition in question. Further and more detailed information can be obtained at the Austro-Hungarian Embassy, Belgrave Square.

New York Electrical Society.—At the meeting of the New York Electrical Society on the 18th ult., the president described briefly the Redde underground system of insulated wires. It consists of glass tubes in lengths of 12 to 16 feet, placed in iron pipes equally distanced from each other, with the spaces between filled with plaster of paris. Mr. Sinclair, of the U.S. Experimental Station (for gunnery) at Sandy Hook, gave a short description of the Howe system of underground wires. He said it was simply a covering of composition of tar, rosin, &c., surrounded with braided cotton, and then painted. Wires thus prepared were laid on a trench 4 feet deep on a board, and fastened with a wooden cleat about one inch apart. They were covered with another board, and the trench was refilled with sand. These wires had worked satisfactorily through the winter, with the ground in some places covered with water and ice. There was no trouble from induction and the usual annoyances.

The British Association.—With reference to the coming meeting of the Association at Montreal, the *Times*, in an article upon the subject, says that, in the case of some of the railways, notably the Canadian Pacific, the free travelling for members began on the 1st of this month. The exact number of those who have received vouchers for Canada is 852; of these about 560 are old members, and it may confidently be expected that the actual attendance at the meeting will be quite up to the average. The greatest precautions have been taken that those who have the advantage of the privileges granted by the committee and by the liberal Canadian Government, shall make legitimate use of them. We regret to learn that Sir Joseph Hooker will be unable to attend the meeting, although he was nominated one of the vice-presidents by the committee. Mr. W. H. Preece will take the place of Mr. Westmacott as a vice-president of Section G. Among those to whom vouchers of membership have been issued, we notice the names of the following:—Prof. J. C. Adams, of Cambridge; Prof. W. G. Adams, of King's College; Mr. John Ball, Prof. R. S. Ball, Astronomer Royal for Ireland; Mr. W. T. Blanford, of the Indian Geological Survey; Sir Frederick Bramwell; Mr. W. Carruthers, of the British Museum; Prof. G. H. Darwin, Prof. Boyd Dawkins, Prof. James Dewar, Sir Frederick Evans, Dr. E. Frankland, Captain Douglas Galton, Dr. J. H. Gladstone, Mr. James Glaisher, Mr. J. W. L. Glaisher, Colonel Godwin Austin, Sir J. H. Lefroy, Dr. Leone Levi, Sir John Lubbock, Prof. H. N. Moseley, Admiral Sir E. Ommanney, Rev. S. J. Perry, Captain Bedford Pim, Right Hon. Sir Lyon Playfair, Lord Rayleigh (President), Prof. Osborne Reynolds, Prof. Chandler Roberts, Prof. Sir E. Roscoe, the Earl of Rosse, Prof. Burdon Sanderson, Mr. Trelawney Saunders, Mr. P. L. Sclater, Mr. R. H. Scott, Sir Richard Temple, Sir William Thomson, Dr. E. B. Tylor, Mr. H. Trueman Wood. The local committee is making the most strenuous efforts to make the meeting a success. It appeals to the public spirit of the citizens of Montreal, and the *Times* believes the appeal has been liberally responded to. It is confidently expected that from five to six hundred persons will be received as guests into the houses of the inhabitants during the meeting of the Association, while a sum of not less than $10,000 will be placed at their disposal by the citizens to enable them adequately to defray the expenses of the meeting. The Associated Cable Companies have arranged to grant free cablegrams to all members of the Association who may at any time desire to communicate on strictly private matters with their friends in England. Each member will be allotted a number; this, and not his name, he will make use of in these cablegrams, which will be addressed in the first instance to the office of the Messrs. Cook, who have kindly undertaken to forward them to their destinations.

Death of M. Volckmar.—A telegram from Paris to the *Times* on Friday, last week, announced:—"Some sensation has been created here to-day by the discovery in the Seine of the body of M. C. Volckmar, one of the founders of the Electrical Power Storage Company. There was a ball in his forehead, and an investigation into the circumstances of his death has been begun."

Telpherage.—Among the exhibits that figure this year in the Royal Agricultural Show at Shrewsbury for the first time, is the telpherage system of Professor Fleeming-Jenkin, which has been described and illustrated in the REVIEW. The Telpherage Company, Limited, has had an experimental line at Weston, Herts, for some time, and has sent one to South America, where it is to be employed in the conveyance of minerals. Professor Jenkin has hopes that in time telpher lines may become common in this country as feeders for railways, for the conveyance of farm produce, for coal mines, brickfields, and the like, and is working steadily towards this end.

The Utilisation of the Niagara Falls.—At a recent meeting of the American Association of Civil Engineers, Mr. Benjamin Rhodes described what had been done and what might be done towards the utilisation of Niagara for electrical purposes. He said: "The power of Niagara can be estimated very approximately. The average flow of the river according to many careful measurements is 275,000 cubic feet per second. The fall in the river through the rapids immediately above the fall is 65 feet. The height of the falls is 165 feet, making a total of 230 feet; thus we have for the whole power 7,000,000 horse-power. To utilise this amount of power by water-wheels, generate electrical currents, and transmit to various cities within 500 miles, would necessitate a plant representing at least $5,000,000,000. Such figures as these give some idea of the enormous amount of power here in reserve." He states that on the Canadian side the entire use of the falls is represented by a small over-shot wheel, which propels a pump, furnishing a meagre supply of water to the adjoining village. On the American side there are five separate raceways, developing in all 800 to 1,000 horse-power. After describing the hydraulic canal, the greatest power now in use at Niagara, he says: "Further developments of power at Niagara may be made at little expense. The hydraulic canal can be deepened and widened, and wheels may be set under greater heads, the total amount thus made available here being equal to the necessities of many years. It may safely be said that the use of Niagara has just begun. Low water is unknown; troubles from ice are slight; hours of use are not limited to 8 or 10, but 24 hours in the day and 365 days in the year, and unlimited power is ready, making this the most reliable, as it is the grandest, water-power in the world."

Conversion of Liquid Batteries into Dry Batteries. — By MM. Bequerel and Onimus. — Several experimentalists, and, among others, Bagration, have sought to obtain batteries more or less dry. The latter, by mixing sand with hydrochlorate of ammonia, arrived at a result which is often put in practice. We have modified this result by mixing gypsum intimately with the exciting liquids, and then allowing it to set. The only batteries for which this process would be advantageous are evidently those which act only when the circuit is closed, and among these the hydrochlorate of ammonia (sal ammoniac) battery, and that with chloride of zinc, are the only ones which present any real advantage. Instead of employing gypsum alone, we mixed it with peroxide of manganese or sesquioxide of iron. Under these conditions the electromotive force is a little greater, and especially with sesquioxide of iron, the renewal of the electromotive force on opening the circuit is very energetic. When the battery is completely exhausted it is merely needful to make it imbibe a solution of the exciting salt to make it act anew. This procedure has the advantage of suppressing the exterior vessel and of giving the elements various forms according to circumstances. In fine, we believe we have succeeded in adding to the actions of ordinary batteries the advantages (considerable in certain cases, *e.g.*, medical apparatus, military telegraphy, &c.) of dry batteries, and that by a simple and inexpensive method.—*Comptes Rendus.*

Female Telegraph Clerks.—Our New York contemporary, the *Electrical Review*, criticises the regulations as regards the marriage of female telegraph clerks as follows:—"Among the many stupid rules governing the telegraph service in England is one which compels female operators to resign their positions in the event of marriage. As a matter of fact, few ladies would probably care to remain in the service after marriage, having enough home duties to occupy their time; but why it should be a matter of Government policy to compel a good operator to give up her position simply because of marriage it is difficult to understand. Certainly it cannot be that the British Government believes it good policy to discourage marriage, yet this is the obvious effect of the rule."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Albion Electric Lamp, Limited.—The annual return of this company, made up to the 17th inst., was filed on the 21st inst. The nominal capital is £10,000 in £10 shares. 195 shares of the first issue, and 691 of the second issue have been taken, and £10 per share has been called upon the former, and 2s. 6d. per share upon the latter. The calls paid amount to £2,036 7s. 6d. Registered offices, 16, West Street, Gateshead.

CITY NOTES, REPORTS, MEETINGS, &c.

The West Coast of America Telegraph Company, Limited.

THE seventh ordinary general meeting of this company was held at Cannon Street Hotel on Thursday, Mr. Robinson Kendal presiding. The directors' report for the year ending the 31st December, 1883, which was submitted to the meeting, showed the gross revenue to be £57,338 12s. 1d., against £38,908 2s. 10d. for the previous year, or an increase of £18,430 9s. 3d., leaving a net balance of profit, after paying debenture interest and all other charges, of £23,314 9s. 7d., a result which fully realised the anticipations of the board, and firmly established the position of the company as a dividend-paying concern.

The report continues:—"An entire cessation of the deplorable conflict still unsettled upon the West Coast, and a natural and consequent revival of trade, might have further increased the earnings of the company; but despite incident drawbacks, the figures of the year's working show a result upon which the board think the shareholders may be fairly congratulated. The shareholders will notice an increase in the expenditure upon the West Coast, but this has mainly arisen from the employment of extra clerks to meet the increase in the company's business, and from the company's share of expenses in establishing a permanent through day and night service between Valparaiso and other places on the West Coast, and England, and the rest of Europe. The cost of this extended and improved service, however, may be regarded as inappreciable when compared with its results, and with the advantages it offers to the commercial and other communities.

Anticipating this report, the Board declared in January last a dividend of 4 per cent., or 8s. per share, which absorbed a sum of £12,000 out of the nett balance of £23,314 9s. 7d. The remainder has been absorbed in forming a reserve fund, and in discharging the last of the liabilities caused by the war and the consequent cessation of the company's business. Regarding the reserve fund, to the formation of which the board have given their anxious attention, it may be stated that at the moment it amounts to a nucleus of more than £10,000, and the board will not fail to add to it as may be determined by the increase in the income of the company and by other material considerations.

Since the 31st December last, the date up to which the balance sheet is made out, the board are happy to announce that a further improvement has taken place in the position and prospects of the company. For the six months ending the 30th June, the receipts amount to the sum of £25,850, or, including the sum of £4,400 received from the Chilian Government, £30,250, against a sum of £23,450 for the corresponding period of last year, showing an increase for this year, so far, of £6,800. Out of this increase the board have declared a dividend for the half year at the rate of 4 per cent. per annum, or four shillings per share, which will absorb a sum of £6,000. This dividend the board propose to make payable on the 25th instant.

After long continued negociations the board have at length settled the company's claim upon the Chilian Government for the sum of £4,400 before referred to. This amount the board looked upon as altogether inadequate to meet the just claim of the company, but having regard to the inexpediency and dubiousness of attempting to litigate in the Chilian Courts a matter which in-

volved delicate questions of local and international law, the board decided to accept the offer of the Government, and bring the matter to this final settlement, which at least has the negative merit of leaving undisturbed the harmonious relations hitherto existing between the Government and the company.

The company's repairing steamer is still kept in the highest state of efficiency and ready at a moment's notice to meet any call upon her services, whilst the electrical condition and general working of the company's cables leave nothing to be desired."

The Secretary, Mr. Fred. L. Robertson, having read the notice convening the meeting,

The Chairman moved the adoption of the report and accounts, remarking that the board were pleased to think that they presented to the shareholders the most satisfactory and improving balance sheet the company had ever had, while they were able at the same time to announce that the company was steadily and surely gaining ground. Two years ago, during the war between Chili and Peru, in consequence of the Chilian Government cutting their cable, they were compelled to mortgage their steamer for between £12,000 and £13,000, besides which they had a balance on the wrong side. Now, not only had they paid off the mortgage and discharged all their liabilities, but they had paid £12,000 in dividends, and were ready to pay another £6,000. Without impairing the efficiency of their service, he thought there would be a diminution rather than an increase in the expenditure during the next year. Although trade was deplorably bad at the present moment on the coast, there was some hope of the termination of the war, and this would no doubt lead to a return of business and prosperity.

Mr. Campbell seconded the adoption of the report, and congratulated the shareholders on the improved position of affairs.

The motion having been put and carried,

Mr. Campbell moved the re-election of the retiring directors, Messrs. Robinson Kendal and Henry Roberts, which was seconded by Mr. MacAndrew, and agreed to; and Mr. John Taylor moved the re-election of Mr. John Weise as auditor, which, having been seconded by Mr. Lamont, was also carried.

Mr. Mason, speaking in high terms of the manner in which Mr. Robinson Kendal had devoted his energies to the service of the company, moved, "That the thanks of the shareholders be given to the chairman and directors for their constant attention and devotion to the interests of the company, and that, in view of the inadequate remuneration received by them in the past, the sum of £1,000 be placed at their disposal out of the funds of the company."

Mr. John Taylor, in seconding this proposal, testified still further to the fact that the chairman had given his whole thoughts and attention to the affairs of the company, and said the sum proposed to be voted to him was by no means adequate remuneration for his services, but was intended more as a token of the appreciation of the shareholders. When Mr. Kendal first joined the board the shares were only worth £2, whereas now they were worth three times that amount, so that there was an actual increase of £120,000 in the market value of the company, leaving the debentures out of the question; and this had been achieved mainly through the exertions of their present chairman.

The motion was unanimously agreed to, and was suitably acknowledged by the chairman, the meeting then terminating.

India Rubber, Gutta Percha, and Telegraph Works Company, Limited.

THE ordinary half-yearly general meeting of this company was held at the Cannon Street Hotel on Tuesday, under the presidency of Mr. S. W. Silver.

The Secretary, Mr. W. J. Tyler, having read the notice convening the meeting,

The Chairman said they had met together for the purpose of confirming a recommendation of the directors for the payment of an interim dividend. When they last met shareholders would probably remember that it was for the purpose of obtaining their sanction to apply to Parliament for a short Act to make the company's memorandum of association clearer and more comprehensive. He was happy to say that the bill received the Royal assent on the 3rd of the present month. He regretted that the chairman (Mr. George Henderson) was unable to be present on account of ill-health. On the last occasion the chairman stated that the year had begun very satisfactorily; that statement he (Mr. Silver) could now confirm, for the general business done exceeded that done in any corresponding period. They had been fairly employed as regarded cable orders; they had contracts for the Government departments and the Western and Brazilian Telegraph Company, and their steamer, the *Dacia*, was employed in carrying the latter's cable to Brazil. They would be glad to know, with regard to the Spanish National Telegraph Company's cables, that the obstacles which hitherto stood in the way had been removed, and an agreement had been entered into between the French and Spanish Governments to land the Senegal cable at the Canaries. Both had made them payments under the contracts, and the work was being gone on with. He hoped that when they met again, not many months hence, the board would be able to render as satisfactory an account as on previous occasions. He concluded by moving, "That an interim dividend of 5 per cent., or 10s. per share, free of income tax, payable on and after the 23rd inst., be now declared."

Mr. Bannatyne seconded this resolution, which was carried unanimously.

Mr. Lamont said he did not suppose the board required their attention directed to China. It seemed to be a field that was likely to open up for telegraph work, and he had no doubt the board were watching it.

Sir William Wallace moved a vote of thanks to the chairman and the board of directors, and also to the officers of the company, for their services for the half-year; and, this having been heartily accorded, the meeting terminated.

The Telegraph Construction and Maintenance Company, Limited.

THE half-yearly general meeting of this company was held at the offices, 38, New Broad Street, on Tuesday, Sir Daniel Gooch, M.P., presiding.

Mr. Shuter, the general manager, having read the notice convening the meeting,

The Chairman stated that they had manufactured during the half-year 4,322 miles of cable. They had laid the French cable between Saigon and Tonquin, 785 miles in length; and the Brazilian Company's duplicate cables between Madeira, St. Vincent, and Pernambuco, amounting to 3,030 miles; and had effected two repairs in that company's original cables; whilst the s.s. *Scotia* was now engaged on a third repair on her way home from the completion of the duplicate lines. The Direct Spanish Company's duplicate cable, 473 miles in length, had been laid between the Lizard and Bilbao; a cable, about 40 miles long, had been laid across the Straits of Sunda; and sundry lengths had been laid in the Australian and China seas, amounting to 560 miles. The total lengths laid were over 4,800 miles, and it might be said that a year's work had been crowded into the first half of it. With regard to electric lighting, it was hoped that the experiment of lighting the Great Western Company's station at Paddington would be completed before the end of the year, and on the success or otherwise of that experiment would probably depend the future action of the company in regard to electric lighting.

Mr. Figgis asked if it was not usual to submit some kind of accounts to the shareholders at these meetings.

The Chairman replied that that was usually done at the annual meeting earlier in the year. It had formerly only been customary to hold one meeting annually, but, in compliance with the request of the shareholders, it was resolved to hold a half-yearly meeting, so that the shareholders might be informed of what was taking place.

Mr. William Abbott said that in 1871 considerable speculation was taking place in the company's shares, and he suggested that they should meet every half-year, in case of any question being asked, to dispel rumours that were being circulated with the view of disparaging their property. Every announcement which had been since made from the chair fully justified the wisdom of this policy, and this company had done wonderfully well, especially taking into consideration the existing state of depression in commercial matters. He moved "that the statement of the chairman to this meeting is satisfactory, and that the best thanks of the meeting be given to the chairman, directors, and officers of the company, for their attention to the business of the company for the past half-year."

This resolution having been unanimously carried and acknowledged by Sir Daniel Gooch, the meeting terminated.

West Middlesex Electric Light Company, Limited.

THE second annual general meeting of this company was held at the offices, Hammersmith, on Wednesday, the 16th inst., Mr. C. Cordingley presided.

The Chairman congratulated the shareholders upon the success of the company in obtaining a provisional order for the Fulham district. The Royal assent was given to the bill on the previous Monday, and it now remained for the company to proceed to carry out the provisions of the order, which were of an extremely satisfactory character. The order practically included the whole of the Fulham district, containing over 40 miles of roads. The first installation was not a large one, yet extensions would be made from time to time until the whole district was covered, and this would be carried out under the present order without the expense of applying to Parliament for fresh powers. The first section of the work to be carried out would be from Addison Road railway bridge, through the Broadway and King Street to Rivercourt, with some of the lateral streets; the Cedars estate, and Brook Green Road. The works for this section were estimated to cost £16,000, and a deposit of £800 only would have to be made to the Board of Trade. Two years was allowed for carrying out this scheme. These were extremely favourable terms, and had been obtained at a moderate cost. Nearly every other provisional order obtained by other Metropolitan companies had lapsed, occasioned in many instances by the enormous deposits required by the local authorities. Thus, one company undertook an installation estimated to cost £50,000, and they were required to deposit £25,000. This was fatal to companies. They had numerous applications for the supply of electric light, and with the improvement effected in appliances, tending to economy of production and storage, he believed that the electric light would emerge from the cloud in which it was at present shrouded, and would prove an effective and economical, a healthy and safe light for domestic and other purposes. It was necessary to fill one

vacancy upon the board of directors, as Mr. W. H. Lefevre had left the neighbourhood, and did not offer himself for re-election.

Mr. Cosh, in moving that the vacancy upon the board should not be filled up at present, spoke of the labours of the directors for the last two years, and said he considered that they had acted wisely in not squandering the capital of the company in the purchase of patents, many of which had cost other companies thousands of pounds, and were not to-day worth sixpence. He traced the difficulties they had had to contend with during the two years of the existence of the company, commencing with the original agreement with the Board of Works, then the almost insurmountable difficulties which arose through the passing of the Electric Lighting Act, with the obtaining of the license, and finally the provisional order. The local authority, from the chairman downwards, had also assisted them in every way, being strongly of opinion that the electric light would prove a great boon to the district.

Mr. Parker seconded the proposition, and stated that the shareholders were well satisfied with the business tact and indefatigable exertions of the board.

The resolution was unanimously carried, and after some formal business, the meeting concluded with a vote of thanks to the directors and chairman.

The Direct United States Cable Company, Limited.

THE following is the report of the directors for the six months ending 30th June to be presented at the next meeting of the company. The revenue for the half-year, after deducting outpayments, amounted to £68,573 8s. 11d. The working and other expenses for the same period, including interest on debentures and income-tax, but exclusive of cost of repairs of cable, amounted to £19,750 2s. 10d., leaving a balance of £48,823 6s. 1d. as the net profit of the half-year, making, with £3,524 8s. 6d. brought forward from the previous half-year, a total of £52,347 14s. 7d. Three quarterly interim dividends of 1¼ per cent. each, amounting to £45,532 10s., have been declared and paid at the usual times during the financial year, and a final dividend of 5s. per share is now proposed, making, with the three interim dividends, 5 per cent. for the year, being a total distribution of £60,710. The appropriation of the above balance of £52,347 14s. 7d. on the revenue account is thus shown :—interim dividend for quarter ending 31st March, 1884, £15,177 10s.; final dividend now proposed, £15,177 10s.; carried to the reserve fund, thereby increasing it to £360,000, £19,030 15s. 11d.; final balance of liquidation expenses, £175 10s. 1d.; carried forward to next account, £2,786 8s. 7d.; total, £52,347 14s. 7d. The interruption in the short section of cable mentioned in the last report has been repaired, and the cost of the repair, £5,127 18s. 9d., has been charged against the reserve fund. The final meeting of the liquidators closing the liquidation and dissolving the old company, took place on the 17th ultimo. The repayment of the £100,000 Six per Cent. Debenture Loan will be made on the date due, viz., 15th October next.

The Globe Telegraph and Trust Company, Limited.

THE following is the report of the directors to be submitted to the eleventh ordinary general meeting to be held on Tuesday next :—

The net revenue of the company for the year, after deduction of expenses, amounts to £189,663 4s., which, with the balance of £1,365 9s. 10d. brought forward, makes a total of £191,028 13s. 10d. From this amount there has been distributed the sum of £131,385 15s. in interim dividends, leaving an available balance of £59,642 18s. 10d.

The directors recommend payment of a final dividend for the year of 3s. per share on the preference shares, and of 3s. 6d. per share on the ordinary shares, making, with the former distributions, a total dividend for the year of 6 per cent. upon the preference shares, and 4¾ per cent. upon the ordinary shares, carrying forward a balance of £2,088 3s. 4d.

In order to provide the £130,130 required to pay for the 11,830 new shares of the Eastern Extension Company, taken up last year, and the £15,000 Telegraph Construction and Maintenance Company's 6 per cent. debentures allotted to this company, the directors have issued 5,655 preference shares, and 5,655 ordinary shares, and they have also transferred 3,182 of the Eastern Extension shares. The company's balance-sheet is now free from liability of any kind.

Forty-four of the shares of the German-Norwegian company have been drawn and paid off at par, and the proceeds carried to the credit of the capital account.

Anglo-American Telegraph Company, Limited.—At a meeting of the board of directors of this company held on Tuesday, it was resolved, after placing the quarterly sum of £37,500 to the renewal fund, to declare an interim dividend for the quarter ending 30th June, 1884, of 17s. 6d. per cent. on the ordinary stock and 35s. per cent. on the preferred stock, payable on the 1st August to the stockholders registered on the books of the company on the 14th July, 1884.

French Electrical Power Storage Company, Limited.—A petition for the winding-up of this company has been presented by the Faure Electric Accumulator Company, Limited, a creditor and contributory of the company, and the petition is directed to be heard before Vice-Chancellor Sir James Bacon on the 2nd of August.

South Kensington Mutual Electric Lighting and Supply Company, Limited.—The creditors of this company are required, on or before the 15th August, to send their names and addresses and the particulars of their claims to George Augustus Cape, 8, Old Jewry, chartered accountant, the official liquidator.

The Submarine Telegraph Company, Limited.—The accounts for the half-year ending June 30th, show a balance, subject to audit, which enables the directors, after adding 15 per cent. of the gross receipts to the reserve fund, to recommend a dividend at the rate of 13 per cent. per annum.

Pyramid Electric Company, Limited.—The creditors of this company are requested to communicate with the liquidators, Messrs. Bernard Le Neve Foster and F. W. T. Brain, at Whitecroft, near Lydney, Gloucester, on or before the 15th August.

Edwin Fox and Company, Limited.—The directors of this company have declared an interim dividend for the six months ending June 30th, at the rate of 10 per cent. per annum.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations, July 24.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	1⅛ - 2	⅛, ¼, ⅜, ½ ⅝, ¾, ⅞
		Do. Do.	10	3½ - 4	
30,000	5	Australasian E. L., Power & Storage Co.	3	..	
24,000	10	British Insulite Co., Ld., "A" Shares..	6	..	
25,000	5	Gt. Western Electric Light & Power Co.	2½	⅜ - ½	
24,980	5	Hammond Elec. Lt. & Power Sply. Co.	5	½ - ⅝	½
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2½	..	
250,000	1	Maxim-Weston Elec. Lt. & Power Co. ..	1	½ - ⅝	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	3½	..	
20,000	5	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	3	½ - ⅝	
		TELEGRAPHS.			
1,802,480*l.*	Stk.	Anglo-American, Limited	100	33 - 34	
2,553,760*l.*	Stk.	Do. Pref. } Def. receiving no div. until	100	58 - 59	58⅝, ¾, 9
2,553,760*l.*	Stk.	Do. Def. } 6 p. c. paid to Pref.	100	7¼ - 7⅝	7½
130,000	10	Brazilian Submarine, Limited	10	9⅝ - 10⅛	9⅝, 10
16,000	10	Cuba, Limited	10	10 - 10½	
6,000	10	Do. 10 per cent. Preference ..	10	16½ - 17½	17
15,000	10	Direct Spanish, Limited	9	4½ - 5	
6,000	10	Do. 10 per cent. Preference ..	10	14½ - 14⅞	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	9½ - 10¼	10¼
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	98 -102	
380,000	10	Eastern, Limited	10	11 - 11⅛	11⅛
70,000	10	Do. 6 per cent. Preference	10	13¾ - 14	13¾, ⅞
200,000*l.*	100	Do. 5 do. Debs., repayable Aug. 1887	100	102-105	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104-108	
500,000	Stk.	Do. 4 do. Debenture Stock	100	96 - 98	
250,000	10	Eastern Exten., Australasia & China, L.	10	11⅛ - 11⅜	11⅛
320,000*l.*	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	110 - 113	
640,000*l.*	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102 - 105	103¾, ½
100,000*l.*	100	Do. 8 per cent. Debenture, 1890	100	102 - 105	
550,000*l.*	100	Eastern & South African, Ld., 5 p. c. } Mort. Deb. Rg. redeemable 1 Jan. 1900 }	100	102- 104	
	100	Do. do. do. To Bearer..	100	..	
20,050	10	German Union Telegraph & Trust, Ld.	10	9 - 9½	
250,000	10	Globe Telegraph & Trust, Ld.	10	6⅞ - 7	7
250,000	10	Do. 6 per cent. Preference	10	12½ - 12⅝	12⅛
150,000	10	Great Northern	10	13½ - 13⅝	
100,000*l.*	100	Do. 5 per cent. Debentures ..	100	100 -103	
300,000*l.*	100	Do. 5 per cent. Debentures ..	100	103 -106	
81,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	22 - 23	
100,000	100	Do. 6 per cent. Debs., 1886 ..	100	100 -103	
18,000	25	Indo-European, Limited	25	30 - 31½	
40,000	10	London Platino-Brazilian, Limited	10	3½ - 3	
100,000	100	Do. 6 per cent. Debentures ..	100	100-102	
12,000	10	Mediterranean Extension, Limited	10	..	
3,200	10	Do. 8 per cent. Preference	10	..	
10,000	8	Reuter's, Limited	8	8 - 8½	8
338,225*l.*	Stk.	Submarine	100	180 -185	
75,000	1	Do. Scrip	1	1⅛ - 1⅜	
4,200	Cert.	Submarine Cables Trust	100	99 -102	
37,350	12	Telegraph Construction and Mainten.	12	32 - 33	
150,000	100	Do. 6 per cent. Bonds, 1889 ..	100	103 -106	
186,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1⅛ - 1⅜	
30,000	10	West Coast of America, Limited	10	6½ - 6⅝	
150,000*l.*	100	Do. 8 per cent. Debs.	100	107 -108	
48,791	15	Western and Brazilian, Limited	15	5⅜ - 5⅝	
24,119	7½	Do. Preferred	7½	4⅜ - 4⅝	
24,119	7½	Do. Deferred	7½	1⅝ - 1⅞	
200,000*l.*	100	Do. 6 p. c.. Debs. "A" 1910 ..	100	104 -107	
250,000*l.*	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	97 -100	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	123 -125	
1,000,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -106	
88,321	10	West India and Panama, Limited	10	½ - 1	
34,563	10	Do. 6 per cent. 1st Preference	10	6½ - 7	
4,669	10	Do. 6 do. 2nd do. ..	10	4½ - 5½	
		TELEPHONES.			
224,850	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅜ - ⅝	½
225,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	½	⅛ - ⅜	
100,000	5	United Telephone Co.	5	9⅞ - 10⅛	
20,000	5	Do. New, issued at £2 pm.	2	4⅛ - 4¼	4⅛

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th July, are £3,120 as compared with £2,529 in the corresponding period of 1883. The March receipts, estimated at £6,235, realised £6,313.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 18th, were £2,209, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1884.

10172. "Voltaic batteries for the decomposition of metals and producing electricity for lighting, &c." W. BOGGETT. Dated July 15.

10190. "Electric tugs for ships, life boats, and other marine and submarine purposes." J. H. BARRY. Dated July 15.

10207. "Secondary voltaic batteries and single fluid primary batteries." C. MOSELEY, Dated July 16.

10215. "Propulsion of tramcars and other vehicles by electricity." A. ECKENZAUN. Dated April 12.

10237. "Electric magnetic meter." C. D. ABEL. (Communicated by Société Maison Bréguet.) Dated July 16.

10238. "Electric safety fuse." R. E. DUNSTON. Dated July 16.

10262. "Forming letters or other characters on paper, &c., from a distance." M. T. NEALE. Dated July 17.

10274. "Galvanic apparatus for prevention of cholera, &c. W. R. LAKE. (Communicated by J. Durien & Cie.) Dated July 17.

10298. "Medical electric hair brushes and apparatus." W. S. FROST, J. L. MERIGOT, G. C. C. FEIN. Dated July 18.

10318. "Handles or electrodes of electro-medical apparatus." J. N. ARONSON, C. B. HARNESS. Dated July 18.

10323. "Dynamo-electric machines." A. M. CLARK. (Communicated by E. B. Cutten.) Dated July 18.

10342. "Telephones." A. HUDSON. Dated July 19.

10351. "Production and simultaneous transmission of a series of similar electrical impulses or currents to different termini." G. DOWNING. (Communicated by W. F. C. M. M'Carty.) Dated July 19. (*Complete.*)

10366. "Electric meter." R. E. DUNSTON. Dated July 19. (*Complete.*)

10373. "Electric fuses and detonators; making same." P. WARD. Dated July 19.

10374. "Electric fuses and detonators; making same." P. WARD. Dated July 19.

10461. "Electrical measuring instruments." F. V. ANDERSEN, A. D. STEVENSON. Dated July 22.

10462. "Electro-magnets." F. V. ANDERSEN. Dated July 22.

10463. "Electrical sounding apparatus." G. DAVIS. Dated July 22.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

5471. "Telegraph and telephone lines, &c." H. H. LAKE. (Communicated from abroad by J. C. Chambers and N. C. Gridley, of America.) Dated November 20. 6d. The said invention consists partly in the combination with one or more aerial electric conductors insulated from the supports and connected with the batteries, and grounded in the usual manner, of one or more induction wires, rods, bands, or strips arranged upon the supports in electrical proximity to the telegraph and telephone electric conductors, and insulated from the supports from the telegraph or telephone electric conductors and from the earth, and so as not to form a complete or closed circuit. It also consists partly in a group or series of telegraph and telephone electric conductors, each provided with an insulating covering, and connected with the batteries and grounded in the usual manner and one or more induction wires, rods, bands, or strips, preferably not covered with insulating material, and so arranged as to be surrounded by some or all of the series or groups of telegraph and telephone electric conductors, and insulated therefrom, from the supports, and from the earth, and so as not to form a complete or closed circuit.

5482. "Electrodes used in the electro amalgamation of gold and silver, &c." R. BARKER. Dated November 22. 2d. The inventor affixes a film or layer of platinum gold or aluminium on the under or exit side of an electrode, and on the top or ingress of the complimentary electrode, deposited thereon by the well known methods used in electro plating, or rivetted thereto, or screwed to, or fixed in any suitable manner, so as to form a film or layer of platinum, gold, or aluminium on the outside of the baser metal. He also uses an alloy of aluminium and copper in such suitable proportions as in practice may be found most advantageous and economical for attaining the object in view. (*Provisional only.*)

5504. "Electrical cut-outs." F. G. HOWARD. Dated November 24. 2d. Consists essentially of two metallic contact pieces fixed within a chamber containing mercury, and communicating with a lower chamber by an orifice closed by an iron plug capable of being raised to unclose the orifice by the influence of a coil or solenoid in the circuit to be controlled. The two contact pieces are placed in electrical communication only by means of the mercury, and the circuit is complete so long as the mercury is contained in the upper chamber, but upon the strength of the current reaching a given point, the iron plug or core is raised by the influence of the coil or solenoid, and allows the mercury to escape into the lower chamber, thus automatically breaking the circuit. (*Provisional only.*)

5524. "Secondary batteries." G. F. PRESCOTT. Dated November 26. 2d. The inventor takes red or other oxide of lead and lead, and intimately agglomerates them in such proportions as may be required by the conductivity determined upon. He carries this out by intimately mixing the oxide and the lead together while subject to a high temperature. The composition may then be solidified by pressure in suitable moulds, and he may or may not embed suitable metallic conductors in the porous mass produced. (*Provisional only.*)

5529. "Electrical railways and tramways." J. ENRIGHT. Dated November 26. 2d. The object of the present invention is to remedy the leakage of electricity from the conductor transmitting it from its source to the motor which drives the carriages. (*Provisional only.*)

5540. "Secondary voltaic batteries." A. KHOTINSKY. Dated November 27. 4d. Relates to a construction of secondary voltaic batteries, whereby the inventor greatly simplifies their manufacture and use, and increases their efficiency. For this purpose, he makes the battery consist of a number of shallow troughs placed one above the other, each trough constituting a cell constructed and arranged as follows. It is made of insulating material, such as glass, ceramic ware, vulcanite, wood, or the like, and it has a low partition of zig-zag form, dividing its bottom into two compartments, the zig-zag branches of the one compartment being interspaced with those of the other. In each of these compartments is laid a sheet of lead or of carbon of corresponding zig-zag form, the sheet in the one compartment being covered with a layer of spongy lead, and that in the other compartment with a layer of a compound of lead such as an oxide. The branches of the sheets are preferably bent into convex form, their middles being raised a little from the bottom of the trough. Over the sheets is poured the exciting liquid of sufficient depth to cover the partition, and conductors, one attached to each sheet, form the electrodes of the cell. Instead of using sheets both of lead or carbon, the negative may be zinc; or the two compartments may be charged with mercury less deep than the partition, a solution of ammonium chloride or magnesium sulphate being used as the exciting liquid. Also the mercury may be used in the one compartment on one side of the partition, and zinc on the other side; and, generally, elements and exciting liquids may be employed such as are used in other forms of voltaic batteries.

5548. "Incandescent electric lamps." J. C. MEWBURN. (Communicated from abroad by J. Kahn and I. Bräuer, both of Vienna.) Dated November 27. 2d. Consists of improvements in incandescent electric lamps, and chiefly relates to arranging their supports or holders so that a sure and uninterrupted electric contact is established between the light giving body within the lamp and the conducting wires outside. (*Provisional only.*)

1884.

5337. "An improvement in secondary batteries." S. KALISCHER. Dated March 22. 2d. Consists in the employment, for the anode, of carbon of any convenient form or nature in combination with a solution of suitable salts of lead, the latter being subjected to the process of electrolysis to produce a dense and solid coating of peroxide of lead upon the carbon, which coating, on being metallically connected with a cathode of lead in the liquid remaining after the process of electrolysis, will constitute a secondary battery of high electromotive force, from which a constant current of long duration can be obtained. According to the principles of this invention, the peroxide of lead is precipitated upon the anode by means of electrolysis, and by means of secondary action, respectively, while the carbon, which as above stated is employed for the anode, remains unchanged.

5502. "Improvements in the electrical transmission of speech." C. E. ALLEN. Dated March 26. 8d. Relates to the reproduction of articulate speech by means of electrical variations produced in an electric circuit by sound waves, and it has for its object to produce in an electric circuit strong and powerful electric variations for the above purposes. It also has for its object to overcome the disturbing effects ordinarily apparent in the receiving instruments caused by electrical disturbances produced by other means than the sound waves which are to be reproduced. It also has for its object to enable the reproduction of sound waves at great distances by the aid of strong and powerful electrical variations.

5624. "Improvements relating to the electric mains employed in district lighting." J. E. H. GORDON. Dated March 28. 6d. This invention has for its object improvements relating to the electric mains employed in district lighting.

5844. "Improvements relating to the conduction and conversion or change of tension of electric currents and apparatus therefor." (Communicated from abroad by L. Bollmann, of Vienna.) Dated April 2. 8d. Relates to a method of and apparatus for reducing galvanic electricity from a high to a lower tension or *vice-versa*, and to the production of such alternating electrical currents as are best suited for the economical action of the said apparatus.

5964. "A new or improved electrical contact apparatus worked by passage of railway trains." E. TYER. Dated April 4.

4d. For the purpose of controlling railway signals, and for giving notice of passage of trains over certain parts of the line, it is often necessary to provide apparatus such that the passage of a train shall make or break electrical contact, so as to close or open a circuit communicating with signals or telegraphic instruments. The present invention relates to apparatus for this purpose.

6116. "Improvements in process of and apparatus for reducing metals by electrolysis." A. J. ROGERS, J. KOEBIG, and H. MANN. Dated April 8. 6d. Relates chiefly to the apparatus for the reduction of the metals, and to a process of separating sodium or potassium from sodium chloride and potassium chloride.

6644. "Construction of electric cables and lines of electric communication and prevention of induction therein." S. F. SHELBOURNE. Dated April 22. 6d. Consists:—Firstly. In an improved method of preparing and insulating the conductors. Secondly. In providing the conductors with shields of metal or other equivalent coatings, and an outer insulation for the same, so as to control and limit inductive action between the conductors. Thirdly. As auxiliary and necessary to the second step, a method of connecting electrically the induction shields with each other, so as to form a system of induction circuits within the cables, avoiding earth connections. Fourthly. In an improved method of assembling or laying together the conductors composing the electric cables; and, Fifthly, the electrical combination of such conductors and their induction shields between different sections of the cables in making up extended lines of communication.

6877. "Improvements relating to incandescent electric lamps." H. WATT. (Communicated from abroad by E. Weston, of America.) Dated April 26. 6d. The objects of this invention are to ensure and maintain good contact between the terminals of the lamp and those of the socket or holder, whilst permitting the lamp to be turned in its holder in either direction, and also to prevent the displacement of the lamp, and injury thereto by the attempts of unskilled persons to remove it from its holder in such a manner as to injure the mechanical or electrical connections.

CORRESPONDENCE.

Continuous Current Inductional Transformers.

As I have no intention to attempt to continue the discussion with Mr. E. L Voice, may I request you to grant me enough of your valuable space to reply to a question put by him in your last issue?

Mr. E. L. Voice asks me to substantiate a statement made in the fourth paragraph of my letter of the 6th.

The apparatus therein mentioned was described many years ago by Mr. J. T. Sprague in the *English Mechanic*. That gentleman also mentions a similar device in a letter entitled "The Transformation of Static Electricity into Voltaic Currents," published in the *English Mechanic* for December 15th, 1882, page 338.

I would also request a little additional space to say that I hope soon to refute Mr. E. L. Voice's assertions by experimental evidence, and that, should I find that I have made any theoretical or practical error, I shall not hesitate to proclaim it to the world, knowing that —in the words of Liebeg—"There is no harm in a man's committing mistakes, but great harm indeed in his committing none, for he is sure not to have worked."

F. de Wolffers.

July 19th, 1884.

Heinrichs v. Westinghouse.

Having lately noticed in your columns the excellent results which Messrs. Alabaster, Gatehouse & Co. have obtained in their test of the Heinrichs dynamo machine, I have read with special interest the letter contained in your last issue, in which Mr. Heinrichs gives a *resumé* of his case against Mr. Westinghouse, and it seems to me as most extraordinary, assuming Mr. Heinrichs's statements to be correct, that a case such as he has put before your readers should be dealt with in an English court of law in the manner indicated. How is it possible that a Judge in the High Court of Justice should dismiss a case which, on the very face of it, is a definite breach of an agreement (assuming Mr. H's statements as correct)? a case plainly stated and with uncontradicted evidence; showing it to be another illustration of how an inventor is treated by a capitalist, and, when seeking redress, how justice is dealt out to him. I for one, and I hope many other brother inventors, will accord him sympathy in his position into which the Judge's decision has placed him, and I hope that he will be enabled to appeal against it.

I think most of your readers will join me in thanking you for allowing such questions to be ventilated in your valuable journal as a warning to others to avoid similar difficulties; although how to do this, how to fight the combined powers and interests of capitalist and lawyers is no easy task.

E.

London, *July 21st*, 1884.

An Electrical Testing Establishment.

In reference to your article on "An Electrical Testing Establishment" in your issue of the 19th inst., we are in a position to bring forward some facts which might probably modify your opinion as to the commercial practicability of some of the suggestions therein made. For several years past we have laid ourselves out to supply to inventors the advantages of an electrical testing establishment, such as that advocated by you, and we have given extended publicity to the fact that arrangements have been made to allow inventors and others every facility, including all necessary apparatus provided in private rooms, for comparing, testing, and perfecting any invention connected with telegraphy, telephony, or electric lighting. We further made arrangements for obtaining the highest professional assistance in relation to this undertaking. In the course of three years, however, we have received but two applications for such facilities and assistance, and these were of a nature to prove to us that in this direction there is not even yet a field large enough to allow of any remunerative result for endeavour and capital expended. Thus, one of the applications was from a submarine cable company, requiring the use of an artificial cable, a Thomson recorder, &c., and also a considerable amount of assistance. It will hardly be credited that the sum of 10s. per diem was considered too high a payment for the facilities in question. In the other case, motive power and the use of a dynamo machine with skilled superintendence and advice was considered as being too dearly purchased at the cost of a five pound note. When it is considered that the rent of rooms suitable for testing may, as in our case, reach the sum of £300 per annum, it is difficult to perceive how an enterprise which you characterise as the most prominent want of electricians at the present moment can be established on a commercial basis.

W. N. Tiddy.

The School of Submarine Telegraphy and Electrical Engineering,
12, Princes Street, Hanover Square, W.,
July 22nd, 1884.

A New Battery.

In this week's issue I notice a short description and sketch of a new battery, the chief novelty of which seems to consist in the use of a perforated porous cell containing granule carbon. I beg to say I have had such a perforated cell in use for the last twelve months, the difference in my case being that, after perforating and charging the pot, I have gone to the further trouble of platinising the whole of the contents, the result being either an admirable Leclanché, Smee, or bichromate cell, according to the solution used. Ordinary sealed Leclanché cells, simply perforated, are quite equal if not superior to the agglomerate arrangements, the perforations, of course, doing away with the resistance of the earthenware, and preventing failure from clogging and greatly facilitating re-charging; while the platinised cell, utilised as a single fluid bichromate, is by far the best bichromate element I have ever used.

W. J. Gardner.

Gloucester.